Attachment D

Integrated Environmental Monitoring Plan

Contents

Figures

Tables

Appendixes

End of current text

Acronyms and Abbreviations

ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ARARs	applicable or relevant and appropriate requirements
ASL	analytical support level
BAT	best available technology
BTV	benchmark toxicity value
CAWWT	converted advanced wastewater treatment facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CIP	Community Involvement Plan
CFR	*Code of Federal Regulations*
CMT	continuous multi-channel tubing
COC	contaminant of concern
CRARE	Comprehensive Remedial Action Risk Evaluation
D&D	decontamination and demolition
DCF	dose conversion factor
DFM	data fusion modeling
DOE	U.S. Department of Energy
DOECAP	U.S. Department of Energy Consolidated Audit Program
EM	Office of Environmental Management
EMP	Fernald Site Environmental Monitoring Program
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FCAB	Fernald Citizens Advisory Board
FEMP	Fernald Environmental Management Project
FFA	Federal Facility Agreement
FFCA	Federal Facility Compliance Agreement
FRESH	Fernald Residents for Environmental Safety and Health
FRL	final remediation level
GEMS	Geospatial Environmental Mapping System
GPMPP	Groundwater Protection Management Program Plan
GWLMP	Groundwater/Leak Detection and Leachate Monitoring Plan
IC Plan	Institutional Controls Plan
IEMP	Integrated Environmental Monitoring Plan
LCS	leachate collection system
LDS	leak detection system
LM	Office of Legacy Management
LM SAP	Legacy Management Sampling and Analysis Plan
LM QAPP	Legacy Management CERCLA Sites Quality Assurance Project Plan
LMICP	Comprehensive Legacy Management and Institutional Controls Plan
MCL	maximum contaminant level
MS/MSD	matrix spike/matrix spike duplicate
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standards Hazardous Air Pollution
NPDES	National Pollutant Discharge Elimination System
NRMP	National Resource Monitoring Plan
NRRP	National Resource Restoration Plan
NRRDP	National Resource Restoration Designs Plan

Acronyms and Abbreviations (continued)

NTU	nephelometric turbidity units
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
OMMP	Operations and Maintenance Master Plan for the Aquifer Restoration and Wastewater Project
OSDF	on-site disposal facility
OU	operable unit
PCCIP	Post-Closure Care and Inspection Plan
PDF	portable document file
ppb	parts per billion
PRG	preliminary remediation goal
PRRS	Paddys Run Road Site
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
ROD	record of decision
SEP	Site-Wide Excavation Plan
SSOD	Storm Sewer Outfall Ditch
SWIFT	Sandia Waste Isolation Flow and Transport
TLD	thermoluminescent dosimeter
U.S.C.	United States Code
VAM3D	Variability Saturated Analysis Model in 3 Dimensions
WAC	waste acceptance criteria

1.0 Introduction

As noted in the executive summary, the Integrated Environmental Monitoring Plan (IEMP) has been integrated into this revision of the Legacy Management and Institutional Controls Plan (LMICP). The IEMP is no longer a stand-alone document with its own review and revision cycle. It will be reviewed and revised each October as part of the annual LMICP review.

1.1 Background

The U.S. Department of Energy's (DOE's) Fernald Preserve has completed its remedial investigation/feasibility study (RI/FS) obligations, and the final RODs for all five Fernald Preserve operable units (OUs) are now in place. Since 1997, the site's focus has been on the safe and efficient execution of site remediation, including facility decontamination and dismantling, the design and construction of waste processing and disposal facilities, waste excavation and shipping, and the continuation of groundwater remediation. In recognition of the increased focus on remedy implementation, DOE developed an integrated environmental monitoring strategy tailored to the near-term cleanup actions. The integrated strategy will continue in post-closure to ensure that environmental monitoring and reporting for all site media including remedy performance monitoring is a coordinated effort.

The basis for the current understanding of environmental conditions at the Fernald Preserve is the extensive site environmental data that have been collected. The data were collected over a 10-year period through the remedial investigation process required under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended, combined with 9 years of subsequent routine environmental monitoring data collected through the IEMP. Analysis of the remedial investigation data resulted in the selection of a final remedy for the Fernald Preserve's environmental media, with the issuance of the *Final Record of Decision* (ROD) *for Remedial Actions at Operable Unit 5* (DOE 1996a) in January of 1996. OU5 includes all environmental media, contaminant transport pathways, and environmental receptors (soil, groundwater, surface water, sediment, air, and biota) at and around the Fernald Preserve that have been affected by past uranium production operations. The remedy for OU5 defines final site-wide cleanup levels and establishes the general areal extent of on- and off-property actions necessary to mitigate the environmental effects of site-production activities.

The IEMP is a formal remedial design deliverable required to fulfill Task 9 of the *Remedial Design Work Plan for Remedial Actions at Operable Unit 5 (*DOE 1996b) and is an enforceable portion of the LMICP. This revision to the IEMP provides an update to the original IEMP (approved in August of 1997) as required by the Remedial Design Work Plan and DOE Order 450.1 (DOE 2003a).

1.2 Program Objectives and Scope

As post-closure and continued cleanup activities are conducted, the need for accurate, accessible, and manageable environmental monitoring information continues to be essential. The IEMP has been formulated to meet this need and will serve several comprehensive functions for the site by:

- Maintaining the commitment to a remediation-focused environmental surveillance monitoring program that is consistent with DOE Orders 450.1 and 5400.5 (DOE 1993) and that continues to address stakeholder concerns. Both orders are listed as "to be considered" criteria in the OU5 ROD and are, therefore, key drivers for the scope of the monitoring program.
- Fulfilling additional site-wide monitoring and reporting requirements activated by the CERCLA ARARs for the OU5 ROD, including determining when environmental restoration activities are complete and cleanup standards have been achieved.
- Providing the mechanism for assessing the performance of the Great Miami Aquifer groundwater remedy, including determining when restoration activities are complete.
- Providing a reporting mechanism for many environmental regulatory compliance monitoring activities (i.e., OSDF groundwater monitoring, Federal Facility Compliance Agreement [FFCA] and elements of the National Pollutant Discharge Elimination System [NPDES] discharge reporting, and the air pathway specific dose estimates required under National Emissions Standards for Hazardous Air Pollutants [NESHAP] Subpart H) with the environmental reporting for DOE Orders 450.1/231.1 (DOE 2005a).
- Providing a reporting interface for project-specific monitoring (i.e., OSDF), which is conducted under a separate attachment to the LMICP (Attachment C, "On-Site Disposal Facility [OSDF] Groundwater/Leak Detection and Leachate Monitoring Plan [GWLMP]").

Under the IEMP, data showing the environmental conditions at the Fernald Preserve are collected, maintained, and evaluated. Performance monitoring results associated with the Fernald Preserve are also evaluated and compared against established thresholds. DOE fulfills its obligation to document environmental monitoring information under the umbrella of the IEMP reports.

The boundary conditions defined in the IEMP are as follows:

- The administrative boundary lies between remedial actions for groundwater south of the Fernald Preserve and those potential remedial actions associated with the Paddys Run Road Site (PRRS) plume. This boundary is shown in the Feasibility Study Report for Operable Unit 5 (DOE 1995a) and the Proposed Plan for Operable Unit 5 (DOE 1995b).
- The programmatic boundary refers to the differentiation between the scope and responsibility associated with the design, implementation, and documentation. OSDF monitoring activities are designated as project-specific monitoring. The designation is based on an evaluation of the pertinent regulatory drivers and DOE policies that have monitoring implications.

The IEMP monitoring programs measure the collective environmental impacts resulting from continued Fernald Preserve cleanup and monitoring activities.

1.3 Plan Organization

The IEMP is composed of seven sections and four appendixes. The remaining sections and their contents are as follows:

- Section 2.0—Post-Closure Strategy and Organization: Provides an overview of the post-closure monitoring strategy and a description of the post-closure organization.
- Section 3.0—Groundwater Monitoring Program: Provides a description of the monitoring activities necessary to track the progress of the restoration of the Great Miami Aquifer and discusses the groundwater monitoring activities necessary to maintain compliance with Resource Conservation and Recovery Act (RCRA) requirements as specified in the Ohio Environmental Protection Agency (OEPA) Director's Findings and Orders dated September 2000; and a description of the integration with the groundwater monitoring program for the OSDF.
- Section 4.0—Surface Water and Treated Effluent Monitoring Program: Provides a description of the routine site-wide surface water monitoring to be performed during post closure to maintain compliance with surface water and treated effluent discharge requirements.
- Section 5.0—Sediment Monitoring Program: Provides a description of the sediment monitoring activities to independently verify the overall effectiveness of the sediment controls.
- Section 6.0—Air Monitoring Program: Provides a description of the site-wide air monitoring to be conducted during post-closure.
- Section 7.0—Program Reporting: Provides a detailed accounting of the reporting elements included within the IEMP reporting framework

Appendix A—The Groundwater Monitoring Approach: Provides detailed justification for the groundwater sampling program.

Appendix B—Surface Water Final Remediation Level (FRL) Exceedances: Provides documentation, by constituent, of the particular sample location where FRLs have been exceeded.

Appendix C—Dose Assessment: Summarizes the IEMP's responsibility for preparing the Fernald Preserve's annual radiological dose assessment related to remediation activities to comply with NESHAP Subpart H requirements and the intention of DOE Order 5400.5.

Appendix D – Natural Resource Monitoring Plan (NRMP): Provides the regulatory requirements and strategy for the monitoring of ecological impacts to wetlands, threatened and endangered species, and terrestrial and aquatic habitats.

The IEMP is organized according to the principal environmental media and contaminant migration pathways routinely examined under the program. For each of the media constituting the program, evaluations of the regulatory drivers and pertinent DOE policies that govern environmental monitoring were conducted. The details and results of this evaluation are presented in Sections 3.0 through 6.0.

1.4 Role of the IEMP in Remedial Action Decision Making

The data generated through the IEMP support a number of management decisions regarding the progressive implementation strategy, sequence, and overall management control of remedial actions. This subsection highlights the following: (1) the key management decisions that will be supported by the IEMP, (2) the organizational responsibilities for making the decisions, (3) the framework and criteria needed to facilitate the decisions, and (4) the communication process for internally conveying the results of the decisions to the respective project organizations and externally to the Fernald Preserve's stakeholders. Each of the environmental media sections of this plan (Sections 3.0 through 6.0) provides detailed discussions of the specific IEMP data-use and decision-making criteria relevant to that particular medium.

The IEMP is the mechanism to assess the continued protectiveness of the remedial actions. The IEMP will specify the type and frequency of environmental monitoring activities to be conducted during remedy implementation, and ultimately, following the cessation of remedial operations as appropriate. The IEMP will delineate the Fernald Preserve's responsibilities for site-wide monitoring of surface water and sediment over the life of the remedy and ensure that FRLs are achieved at project completion. The IEMP will also serve as the primary vehicle for determining (to U.S. Environmental Protection Agency's (EPA's) and OEPA's satisfaction) that remedial action objectives for the Great Miami Aquifer are being attained. In addition to these FRL attainment responsibilities, the IEMP will also define site-wide remedial monitoring requirements for air.

1.4.1 Management Decisions

The IEMP supports the following key management decisions:

- From an environmental media perspective, do the completed remedial actions remain protective of human health and the environment?
- From a site-wide perspective, is the Fernald Preserve maintaining compliance with its various regulatory requirements for environmental monitoring?
- Are there any trends in the site-wide environmental monitoring data that indicate the potential for an unacceptable future condition?
- In the event of a regulatory non compliance situation or potentially unacceptable cumulative trend, what activities or projects are the principal contributors to the situation? What specific response actions must be taken to address the situation?
- What communication with regulatory agencies or other concerned stakeholders is necessary as a result of the situation and/or decisions made?
- As discussed in the next subsection, Legacy Management (LM) decision makers will be conducting ongoing evaluations of the data generated at the site to ensure satisfactory conditions are maintained.

1.4.2 Who is Responsible for Making the Decisions?

The environmental data are used by LM personnel to monitor the acceptability of the site activities underway. The bulk of the day-to-day planning and routine operating decisions will be internal to the Fernald Preserve, with process adjustments implemented on a situation-specific, as-needed basis.

In the majority of cases, the data evaluation will conclude that all regulatory requirements are being met and that no unacceptable cumulative trends in the monitoring data are present. The evaluation and conclusions will be documented for regulatory agency concurrence through the normal reporting mechanisms described in this plan.

LM will notify EPA and OEPA immediately (prior to taking an action internally) if an evaluation indicates that attainment of a regulatory schedule milestone is in jeopardy because of the mitigative actions necessary to address an adverse cumulative situation

LM personnel will (1) identify the root cause of the unacceptable situation, (2) determine the options for addressing the problem, and (3) communicate with EPA and OEPA to arrive at a mutually acceptable decision concerning the follow-up actions to be taken. Immediate notification to EPA and OEPA will be made via telephone, followed by written communication. For all remaining situations (i.e., those involving the Fernald Preserve's responses to undesirable data trends for any of the environmental media), LM personnel will identify and implement appropriate actions internally, and will document the decisions and resultant response actions via telephone or in the annual site environmental reports.

Subject matter experts are responsible for the ongoing review of media-specific monitoring data and the identification of any related environmental-compliance issues. If the potential for an unacceptable future situation is identified, then options for addressing the problem will be identified. The options will be assessed with respect to their implications, and the results of the evaluations will be communicated as necessary to the Fernald Preserve's stakeholders, EPA, and OEPA.

1.4.3 What Are the General Criteria for the Decisions?

The IEMP establishes, on a medium-specific basis, the types of data and thresholds or regulatory limits required to support the management decisions described above. Each set of medium-specific criteria is handled uniquely because of the varying medium-specific locations where the regulatory criteria are applied.

The medium-specific sections of this plan identify monitoring requirements and ARARs for each environmental medium with the applicable compliance locations. Additionally, the medium-specific sections define the criteria to be used to identify trends in the data that could indicate an imminent unacceptable situation. Each of the medium-specific sections specifies the frequency of the data evaluations to satisfy the Fernald Preserve's overall planning and decision making requirements. DOE will evaluate the data accordingly and will report the results according to the approach summarized below.

1.4.4 How Will IEMP Decisions Be Communicated?

Each medium section of this IEMP (Sections 3.0 through 6.0) presents medium-specific reporting components, and Section 7.0 summarizes the overall reporting strategy for the IEMP. LM information is available on the DOE Office of LM website (http://www.lm.doe.gov/). The Fernald data will be made available to the regulatory agencies on an ongoing basis in the form of electronic data files through this site at the following link: http://www.lm.doe.gov/land/sites/oh/fernald/fernald.htm. Fernald-specific information will continue to be available in query form through the Geospatial Environmental Mapping System (GEMS) and through downloadable files (both types of data are accessible through the above-referenced link). GEMS is a Web-based application that provides access to data queries upon completion of data review. The annual site environmental reports will also be issued as part of the IEMP program. The report will provide a reporting mechanism for IEMP data to meet regulatory-compliance requirements pertinent to site-wide interpretation.

The routine process adjustment decisions (e.g., converted advanced wastewater treatment [CAWWT] facility) will not necessarily be reported as part of the IEMP reports. These types of routine decisions will be maintained as part of the daily operations logs and are considered to be normal in the course of day-to-day practice in order to achieve operating objectives. The major project control decisions will be summarized in the annual site environmental reports. The decision reporting format will include (1) a description of the pending adverse conditions, (2) the actions taken to respond to the situation, and (3) the mitigation results obtained. All such internal decisions will be made consistent with the Fernald Preserve’s enforceable work plans and ARAR compliance requirements. Once a mutually agreeable decision is reached, the actions will be implemented. The decision process, actions taken, and results obtained will be summarized in the annual site environmental reports.

The annual site environmental reports will be furnished to EPA and OEPA in accordance with the provisions summarized in Section 7.0. The annual site environmental reports will also be available for review by the Fernald Preserve’s stakeholders at the Visitors Center and the Public Environmental Information Center and to select stakeholders via mail.

2.0 Fernald Preserve Post-Closure Strategy and Organization

This section presents a description of the Fernald Preserve's post-closure strategy and organizational structure associated with post-closure activities, which includes the continuing OU5 (i.e., environmental media) remediation and monitoring efforts.

2.1 Post-Closure Strategy

The Fernald Preserve's post-closure strategy reflects the completion of the majority of CERCLA activities at the site. There have been extensive site characterization activities to determine the nature and extent of contamination, baseline risk assessments, and detailed evaluation and screening of remedial alternatives leading to a final remedy selection as documented in the ROD for each OU. The majority of all OU remediation activities were completed in 2006. In 2008, the remaining OU with continuing remediation efforts is OU5. Table 2–1 provides a summary of the OU5 remedy overview.

During post-closure, active remediation of the Great Miami Aquifer will continue. Additionally, surface water surveillance monitoring (including NPDES monitoring), sediment surveillance monitoring, and natural resources restoration activities will also continue. The sources associated with air monitoring requirements were removed in 2006; however, limited monitoring will continue to ensure that all air monitoring requirements have been met and levels are acceptable from a closure standpoint. It is anticipated that air monitoring will cease in the future, but agency approval will be secured before ceasing this activity.

2.2 Post-Closure Organization

The post-closure organizational structure is much simplified over previous Fernald organizations. Adequate staff will remain at the site to continue to meet regulatory and OU5 commitments.

2.3 Post-Closure Status

In 2006, the contaminant sources that were at the Fernald Preserve were removed. Soil and on-property sediments were certified, with the exception of those areas indicated in Figure 2–1. Great Miami Aquifer restoration activities continue post-closure as does surveillance monitoring for surface water, sediment, and air. Natural resource restoration activities also continue post-closure. Monitoring associated with the IEMP is mainly associated with these activities. Figure 2–2 shows the site configuration during post-closure.

Table 2–1. OU5 Remedy Overview

OU	Description	Remedy Overview
OU5	Environmental Media • Groundwater • Surface water and sediments (on-property sediment cleanup completed) • Soil not included in the definitions of OU1 through OU4 (cleanup completed with the exception of those areas identified in Figure 2–2) • Flora and fauna	ROD Approved: January 1996 An Explanation of Significant Differences document was approved in November 2001, formally adopting EPA's Safe Drinking Water Act Maximum Contaminant Level for uranium of 30 μg/L as both the FRL for groundwater remediation and the monthly average uranium effluent discharge limit to the Great Miami River. Continued extraction of contaminated groundwater from the Great Miami Aquifer to meet FRLs at all affected areas of the aquifer. Treatment of contaminated groundwater, storm water, and wastewater to attain concentration and mass-based discharge limits and FRLs in the Great Miami River. Continued site restoration, institutional controls, and post-remediation maintenance. Completion of excavation of contaminated soil and sediment to meet FRLs.* Excavation of contaminated soil containing perched water that presents an unacceptable threat, through contaminant migration, to the underlying aquifer. Completion of on-site disposal of contaminated soil and sediment that meet the OSDF waste acceptance criteria. Soil and sediment that exceed the waste acceptance criteria for the OSDF will be treated, when possible, to meet the OSDF waste acceptance criteria or will be disposed of at an off-site facility.

* Due to elevated uranium concentration in retained surface water in the area between former waste pit 3 and Paddys Run, additional soils in the area will be removed as a maintenance activity.

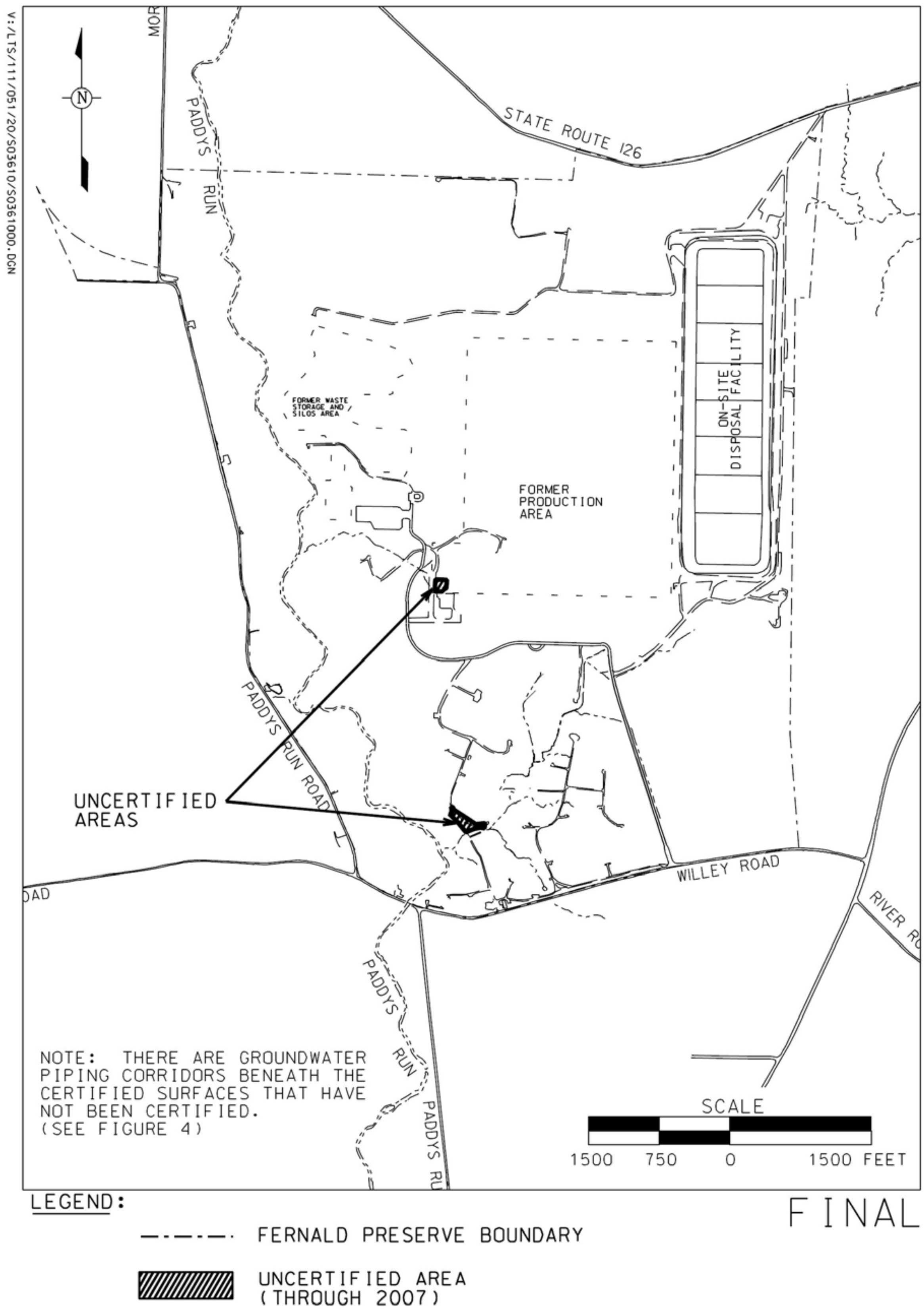

Figure 2–1. Uncertified Areas

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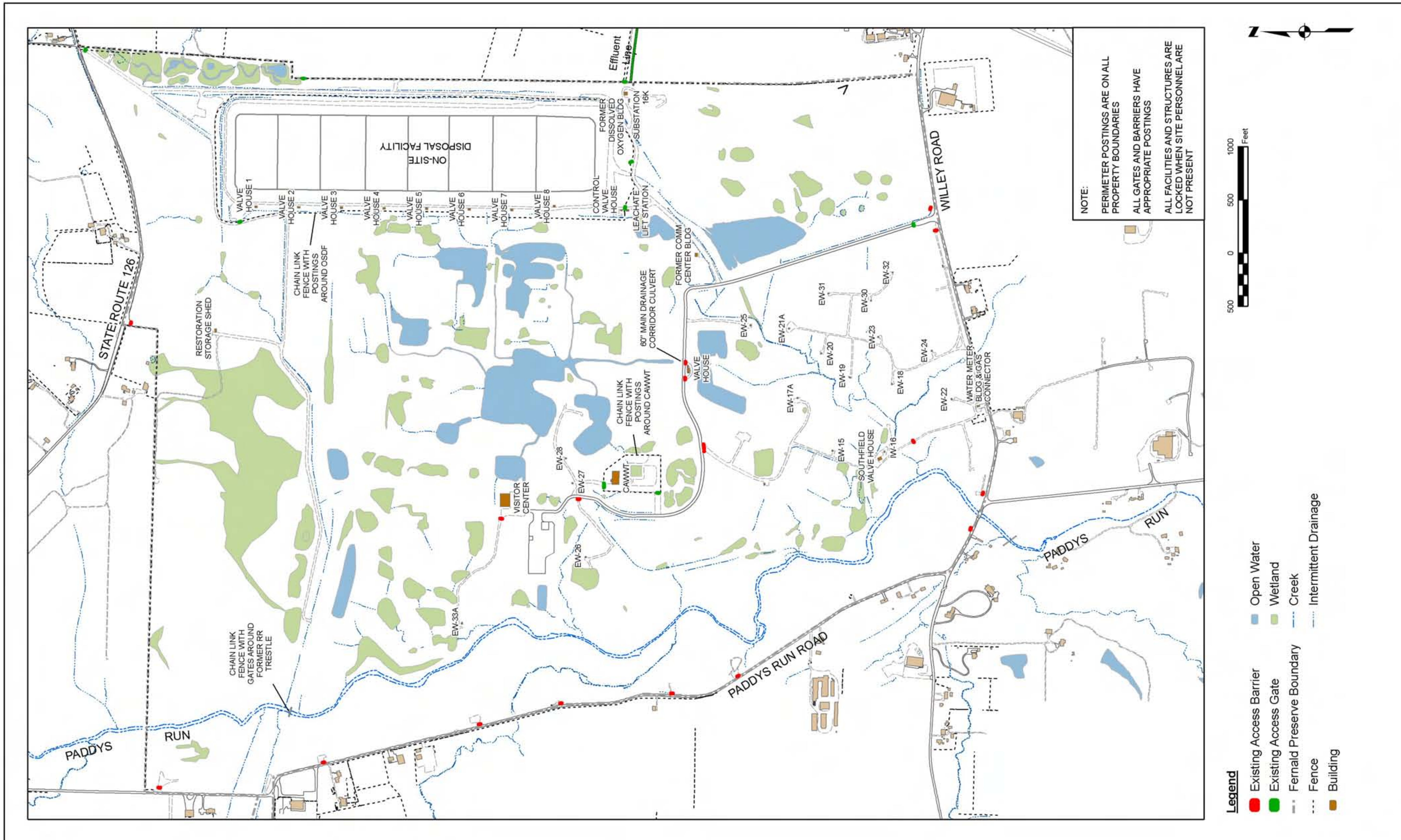

Figure 2–2. Fernald Preserve Site Configuration

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3.0 Groundwater Monitoring Program

Section 3.0 presents the monitoring strategy for tracking the progress of the restoration of the Great Miami Aquifer and satisfying the site-specific commitments related to groundwater monitoring. A medium-specific plan for conducting all groundwater monitoring activities is provided. Program expectations are outlined in Section 3.4, and the program design is presented in Section 3.5.

3.1 Integration Objectives for Groundwater

The Fernald Groundwater Certification Plan (DOE 2006b) defines a programmatic strategy for certifying the completion of the aquifer remedy. Remediation of the Great Miami Aquifer is being conducted using pump-and-treat technology, and it is progressing toward certification through a staged process. The six stages are:

Stage I: Pump-and-Treat Operations
Stage II: Post–Pump-and-Treat Operations/Hydraulic Equilibrium State
Stage III: Certification/Attainment Monitoring
Stage IV: Declaration and Transition Monitoring
Stage V: Demobilization
Stage VI: Long-Term Monitoring

The groundwater sampling specified in the IEMP tracks the performance of the Great Miami Aquifer groundwater restoration remedy. The IEMP is the controlling document for groundwater remedy performance monitoring and is currently focused on groundwater monitoring needed to support Stage I (Pump-and-Treat Operations). Groundwater monitoring requirements for Stages II through VI of the groundwater certification process will be defined in future revisions of the IEMP. The following is a brief description of the stages listed above:

Stage I – Pump-and-Treat Operations

The aquifer remedy is currently in Stage I. The principal contaminant of concern is uranium. Groundwater is being pumped from contaminated portions of the aquifer and treated for uranium.

A phased approach to remediation of the aquifer has been organized around three groundwater restoration modules:

1. The South Plume Module
2. The South Field Module
3. The Waste Storage Area Module

An overview of each aquifer restoration module is provided in Section 3.4, and Figure 3–1 identifies the location of these aquifer restoration modules. As discussed in Section 3.4, the aquifer remedy once included a re-injection module.

Pump-and-treat operations will continue for each groundwater module until FRL concentrations in the aquifer have been achieved or until the mass removal efficiency of the extraction system

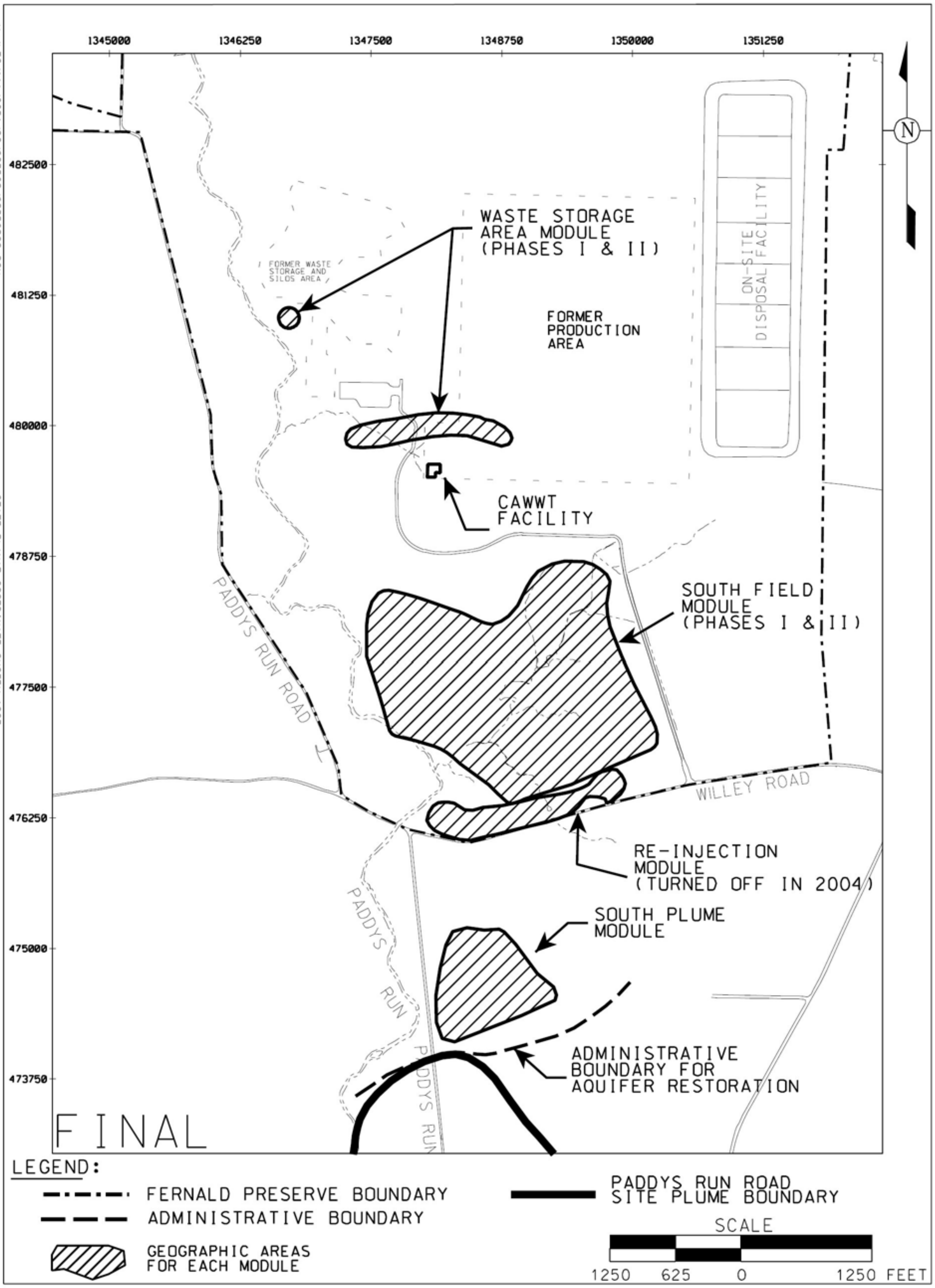

Figure 3–1. Location of Aquifer Restoration Modules

has decreased such that it is apparent groundwater FRL concentration limits in the aquifer cannot be achieved. The controlling document for the operation of the pump-and-treat system is Attachment A the Operations and Maintenance Master Plan for Aquifer Restoration and Wastewater Treatment (OMMP). Ultimately, the IEMP will be used to document the approach to determine when the various modules complete pump-and-treat operations. Monitoring requirements needed to support later stages of the certification strategy will be incorporated into future revisions of the IEMP when deemed appropriate.

The design of the groundwater monitoring program was developed in recognition of:

- Operation of the South Field (Phases I and II) Module
- Operation of the South Plume Module
- Operation of the Waste Storage Area (Phases I and II) Module

Along with this performance-based responsibility, the IEMP serves to integrate several former compliance-based groundwater monitoring or protection programs:

- OEPA Director's Findings and Orders for property boundary groundwater monitoring to satisfy RCRA facility groundwater monitoring requirements (OEPA 2000)
- Private well sampling
- Groundwater Protection Management Program Plan

As discussed in Section 3.7, these activities were brought together under a single reporting structure to facilitate regulatory agency review of the progress of the OU5 groundwater remedy.

<u>Stage II—Post Pump-and-Treat Operations/Hydraulic Equilibrium State</u>

Stage II monitoring will begin on a module-specific basis when pump-and-treat operations have stopped. The objective will be to document that the aquifer has readjusted to steady-state non-pumping conditions prior to proceeding to Stage III (Attainment Monitoring). During Stage II, groundwater levels will be routinely measured to document that steady-state water level conditions have been achieved. Groundwater FRL constituent concentrations will also be routinely measured. If uranium concentrations rebound to levels above the groundwater FRL during the steady-state assessment, then pumping operations would resume. If uranium concentrations remain below the groundwater FRL during the steady-state assessment and do not appear to be trending up toward the groundwater FRL, then the certification process will proceed to Stage III (Certification/Attainment Monitoring). It is anticipated that Stage II monitoring will take approximately 3 months.

<u>Stage III—Certification/Attainment Monitoring</u>

Certification/attainment monitoring will also be module specific. Data collected during Stage III will be used to document that remediation goals have been met and that the goals will continue to be maintained in the future. Statistical tests will be used to predict the long-term ability to stay below FRL constituent concentrations.

Stage IV—Declaration and Transition Monitoring

Because certification is being approached on a module-specific basis, efforts need to be taken to ensure that upgradient plumes do not migrate into and re-contaminate downgradient areas where remediation goals have been achieved. A few monitoring wells will be positioned at the upgradient edge of the clean areas and will be monitored to document that the upgradient plume is not impacting the clean area. It is anticipated that Stage IV monitoring could be conducted for as long as 10 years, essentially the time when the groundwater model predicts that cleanup goals will be achieved in the South Plume Module versus the Waste Storage Area Module.

Stage V—Demobilization

Stage V identifies that all structures, trailers, liners, pipes (except the outfall line), and utilities dedicated for aquifer restoration and wastewater treatment will need to be properly decontaminated and dismantled in order to be protective of the environment. With the exception of the water treatment facility, the decontamination and dismantling (D&D) of infrastructure will not take place until the entire aquifer has been certified clean. This will provide the means to reinitiate pumping in any area of the aquifer that may require additional pumping prior to achieving final certification.

Stage VI – Long-Term Monitoring

Long-term monitoring will be conducted in former source areas after the last groundwater module is certified clean. If the water table rises to an elevation that exceeds what was previously recorded for a former source area, then groundwater monitoring beneath the former source area will be initiated to determine if any new sources have dissolved into the groundwater.

3.2 Summary of Regulatory Drivers, DOE Policies, and Other Fernald Preserve–Specific Agreements

This section presents a summary evaluation of the regulatory-based requirements and policies governing the monitoring of the Great Miami Aquifer. The intent of the section is to identify the pertinent regulatory drivers, including applicable or relevant and appropriate requirements (ARARs) and to-be-considered requirements, for the scope and design of the Great Miami Aquifer groundwater monitoring system. These requirements are used to confirm that the program design satisfies the regulatory obligations for monitoring that have been activated by the OU5 ROD and to achieve the intentions of other pertinent criteria, such as DOE Orders and the Fernald Preserve's existing agreements that have a bearing on the scope of groundwater monitoring.

3.2.1 Approach

The analysis of the regulatory drivers and policies for groundwater monitoring was conducted by examining the suite of ARARs and to-be-considered requirements in the five approved CERCLA OU RODs to identify the subset with specific groundwater monitoring requirements. The Fernald Preserve's existing compliance agreements issued outside the CERCLA process were also reviewed.

3.2.2 Results

The following regulatory drivers, compliance agreements, and DOE policies were found to govern the monitoring scope and reporting requirements for remedy performance monitoring and general surveillance of the protectiveness of the Great Miami Aquifer groundwater remedy:

- The CERCLA ROD for remedial actions at OU5 requires the extraction and treatment of Great Miami Aquifer groundwater above FRLs until the full, beneficial use potential of the aquifer is achieved, including use as a drinking water source. The FRLs are established by considering chemical specific ARARs, hazard indices, and background and detection limits for each contaminant. Many Great Miami Aquifer FRLs are based on established or proposed Safe Drinking Water Act maximum contaminant levels (MCLs), which are ARARs for groundwater remediation. For Fernald Preserve related contaminants that do not have an established MCL under the Safe Drinking Water Act, a concentration equivalent to an incremental lifetime cancer risk of 10 5 for carcinogens or a hazard quotient of 1 for non carcinogens was used as the FRL, unless background concentrations or detection limits are such that health-based limits could not be attained. (In these cases the background or detection limit became the FRL.) The FRLs will be tracked throughout all affected areas of the aquifer and will be the basis for determining when the Great Miami Aquifer restoration objectives have been met. By definition, the OU5 ROD incorporates the requirements of the Fernald Preserve's existing CERCLA South Plume Removal Action (which was the regulatory driver for the former Design Monitoring and Evaluation Program Plan and the Groundwater Monitoring and Reporting Program).
- Per the CERCLA Remedial Design Work Plan for remedial actions at OU5, monitoring will be conducted following the completion of cleanup as required to assess the continued protectiveness of the remedial actions. The IEMP will specify the type and frequency of environmental monitoring activities to be conducted during remedy implementation and ultimately, following the cessation of remedial operations as appropriate. The IEMP will delineate the Fernald Preserve's responsibilities for site-wide monitoring over the life of the remedy, and ensure that FRLs are achieved at project completion. The IEMP will also serve as the primary vehicle for determining to EPA and OEPA's satisfaction that remedial action objectives for the Great Miami Aquifer have been attained.
- The September 10, 1993, OEPA Director's Findings and Orders required groundwater monitoring at the Fernald Preserve's property boundary to satisfy RCRA facility groundwater monitoring requirements (OEPA 1993), and have been superseded by Director's Final Findings and Orders, issued September 7, 2000. The September 7, 2000, Director's Final Findings and Orders specify that the site's groundwater monitoring activities will be implemented in accordance with the IEMP. The revised language allows modification of the groundwater monitoring program as necessary via the IEMP revision process without issuance of a new order.
- DOE Order 450.1, *Environmental Protection Program*, establishes the requirement for a Groundwater Protection Management Program Plan (GPMPP) for DOE facilities. The required informational elements of a GPMPP are fulfilled by the remedial investigation (DOE 1995c) and feasibility study reports for OU5. The groundwater monitoring program requirement is being fulfilled by the IEMP. This also satisfies DOE Manual 435.1 (DOE 2001a), which refers to DOE Order 5400.5.
- DOE Order 5400.5, *Radiation Protection of the Public and Environment*, establishes radiological dose limits and guidelines for the protection of the public and environment.

Demonstration of compliance with these limits and guidelines for radiological dose is based on calculations that make use of information obtained from the Fernald Preserve's monitoring and surveillance program. This program is based on guidance in the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991). The Fernald Preserve's private well sampling program for the Great Miami Aquifer (that was previously in the Fernald Preserve Environmental Monitoring Plan [DOE 1995d]) is conducted to satisfy the intention of this DOE Order with respect to groundwater. While most private well water users in the affected area are now provided with a public water supply, a limited private well sampling activity will be maintained to supplement the groundwater monitoring network provided by monitoring wells. A dose assessment is no longer required due to the availability of a public water supply.

- The 1986 Federal Facilities Compliance Agreement requires that the Fernald Preserve maintain a sampling program for daily flow and uranium concentration of discharges to the Great Miami River and report the results quarterly to the EPA, OEPA, and Ohio Department of Health. The sampling program conducted to address this requirement has been modified over the years and is currently governed by an agreement reached with EPA and OEPA in early 1996 with modifications documented in IEMP revisions. For groundwater, this agreement is specifically related to the South Plume well field to quantify the amount of uranium removed and total volume of groundwater extracted.

The groundwater monitoring plan provided in this IEMP has been developed with full consideration of the regulatory drivers described above. Each of these drivers, and the associated monitoring conducted to comply with these drivers, is listed in Table 3–1. This table also lists each regulatory requirement for the OSDF groundwater monitoring program and the associated project-specific plan. Sections 3.7 and 7.0 outline the current and long-range plan for complying with the reporting requirements contained in the IEMP drivers.

Project-specific groundwater monitoring is required only for one project—the OSDF. The IEMP will not be used as the mechanism for conducting OSDF performance monitoring within the glacial overburden and the Great Miami Aquifer. A leak detection monitoring program plan, which includes both leachate and groundwater monitoring as part of a leak detection program, was submitted separately from the IEMP and initially approved by EPA and OEPA in 1997. The OSDF monitoring requirements include the regulatory drivers, the ARARs, and to-be-considered criteria that have a bearing on the design and execution of a groundwater monitoring program for the OSDF and are as follows:

- Ohio Solid Waste Disposal Facility Groundwater Monitoring Rules, Ohio Administrative Code (OAC) 3745 27 10 specify groundwater monitoring program requirements for sanitary landfills. These regulations describe a three tiered program for detection, assessment, and corrective measures.
- RCRA/Ohio Hazardous Waste Groundwater Monitoring Requirements for Regulated Units, 40 Code of Federal Regulations (CFR) 264.90 through .99 (OAC 3745 54 90 through 99) and 40 CFR 265.90 through .94 (OAC 3745 65 90 through 94), which specify groundwater monitoring program requirements for surface impoundments, landfills, and land treatment units that manage hazardous wastes. Because the Ohio regulations are at least as stringent, and in some cases more stringent, they are the controlling regulations.

- Uranium Mill Tailings Reclamation and Control Act Regulations, 40 CFR 192.32(A)(2), which specify standards for uranium byproduct materials in piles or impoundments. These regulations require conformance with the RCRA groundwater monitoring performance standard in 40 CFR 264.92. Compliance with RCRA/Ohio Hazardous Waste rules for groundwater monitoring will fulfill the substantive requirements for groundwater monitoring in the Uranium Mill Tailings Reclamation and Control Act regulations.
- Ohio Solid Waste Disposal Facility Rules, OAC 3745 27 19(M)(4) and (5), which require submittal of an annual operational report, including a summary of the quantity of leachate collected for treatment and disposal, location of leachate treatment, verification that the leachate management system is operating properly, and the results of analytical testing of an annual grab sample of leachate for groundwater monitoring constituents listed in Appendix I of OAC 3745 27 10.

Table 3–1. Fernald Preserve Groundwater Monitoring Program Regulatory Drivers and Responsibilities

	DRIVER	ACTION	
	CERCLA ROD for OU5	The IEMP describes routine monitoring to ensure remedy performance and to evaluate impacts of remediation activities to the Great Miami Aquifer. The IEMP will be modified toward completion of the remedial action to include a sampling plan to certify achievement of the FRLs.	
	OEPA Director's Final Findings and Orders; RCRA/Hazardous Waste Facility Groundwater Monitoring	The IEMP describes routine monitoring at wells located at the property boundary to ensure remedy performance and to evaluate impacts of remediation activities to the Great Miami Aquifer.	
	DOE Order 450.1, *Groundwater Protection Management Plan*. Also satisfies DOE M 435.1 which refers to DOE Order 5400.5	The IEMP describes routine monitoring to ensure remedy performance of the Great Miami Aquifer.	
	Federal Facilities Compliance Agreement, Radiological Monitoring	The IEMP describes the routine sampling and reporting of the South Plume well field in terms of the total volume extracted and the amount of uranium removed.	
IEMP	OAC 3745-27-10, Ohio Solid Waste Disposal Facility Groundwater Monitoring	A leak detection monitoring program in the glacial overburden and the Great Miami Aquifer is being conducted for the OSDF.	Groundwater, leak detection, and leachate monitoring plan for the OSDF
	40 CFR 264.90-.99 (OAC 3745-54-90 through 99); 40 CFR 265.90-.94 (OAC 3745-65-90 through 94), RCRA/Ohio Hazardous Waste Disposal Facility Groundwater Monitoring	A leak detection monitoring program in the glacial overburden and the Great Miami Aquifer is being conducted for the OSDF.	Groundwater, leak detection, and leachate monitoring plan for the OSDF
	Uranium Mill Tailings Reclamation and Control Act Regulations Groundwater Monitoring for Disposal Facilities	A leak detection monitoring program in the Great Miami Aquifer is being conducted for the OSDF.	Groundwater, leak detection, and leachate monitoring plan for the OSDF
	OAC 3745-27-19(M)(4) and (5), Ohio Solid Waste Disposal Facility Leachate Detection and Collection Systems	Monitoring of OSDF leachate detection and collection systems is included in the OSDF leak detection monitoring program.	Groundwater, leak detection, and leachate monitoring plan for the OSDF

Note: Refer to Appendix A of Attachment C — *On-site Disposal Facility Groundwater/Leak Detection and Leachate Monitoring Plan* for ARARs and other regulatory requirements.

3.3 Groundwater Monitoring Program Boundaries

Administrative Boundary between the IEMP and Paddys Run Road Site Contaminant Plumes
As described in the remedial investigation report for OU5 (refer to Section 4.8.2), the PRRS consists of two facilities: PCS Purified Phosphates (formerly Albright and Wilson Americas Inc.) and Ruetgers-Nease Chemical Company Inc. PCS Purified Phosphates occupies the northern portion of the site and manufactures phosphate compounds. Rutgers-Nease manufactures aromatic sulfonated compounds and occupies the southern portion of the site.

The PRRS Remedial Investigation Report released in September 1992 documented releases to the Great Miami Aquifer of inorganics, volatile organic compounds, and semi-volatile organic compounds. The Proposed Plan for OU5 acknowledged that DOE's role and involvement, if any, in OEPA's ongoing assessment and cleanup of the PRRS plume would be separately defined as part of the PRRS response obligations and in accordance with the PRRS project schedule. Groundwater monitoring will continue south of the Administrative Boundary until certification of the off-property South Plume is complete. This monitoring will assess the nature of the 30-µg/L total uranium plume south of the Administrative Boundary and the impact that pumping of the South Plume extraction wells has on the PRRS plume.

Boundary for Performance Monitoring at the OSDF
As previously mentioned, the OSDF monitoring is conducted under a separate plan. OSDF monitoring results will be reported on the DOE-LM site and in the annual site environmental reports. Evaluation of baseline conditions and long-term monitoring will also be provided in the annual site environmental reports.

3.4 Program Expectations and Design Considerations

3.4.1 Program Expectations

The IEMP groundwater monitoring program is designed to provide a comprehensive monitoring network that will track remedial well-field operations and assess aquifer conditions. The expectations of the monitoring program are to:

- Provide groundwater data to assess the capture and restoration of the 30-µg/L total uranium plume.
- Provide groundwater data to assess the capture and restoration of non-uranium FRL constituents.
- Provide groundwater data to assess groundwater quality at the downgradient Fernald Preserve property boundary and off site at the leading edge of the 30-µg/L total uranium plume.
- Provide groundwater data that are sufficient to assess how reasonable are model predictions over the long term.
- Provide groundwater data to assess the impact that the aquifer restoration is having on the PRRS plume.
- Continue to fulfill DOE Order 450.1 requirements to maintain an environmental monitoring plan for groundwater.
- Continue to address concerns of the community regarding the progress of the aquifer restoration.

3.4.2 Design Considerations

3.4.2.1 Background

The Great Miami Aquifer is contaminated with uranium and other constituents from the Fernald Preserve. An evaluation of the nature and extent of contamination in the Great Miami Aquifer can be found in the Remedial Investigation Report for Operable Unit 5. Uranium is the principal constituent of concern (COC).

Figures 3–2a and 3–2b show the maximum total uranium plume map (30 µg/L uranium or higher) as of the second half of 2006. These maps represent a compilation of several different monitoring depths within the aquifer, and they illustrate the maximum lateral extent of the plume at all depths. The majority of the top of the plume is situated at the water table. In some regions of the aquifer, however, the top of the plume is situated below the water table. More detailed presentations of the geometry of the uranium plume can be found in Appendix G of the *Baseline Remedial Strategy Report, Remedial Design for Aquifer Restoration (Task 1)* (DOE 1997a); the *Conceptual Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas* (DOE 2000a); the *Design for Remediation of the Great Miami Aquifer South Field (Phase II) Module* (DOE 2002), and the *Waste Storage Area (Phase II) Design Report* (DOE 2005b).

The primary sources of contamination at the Fernald Preserve that contributed to the present geometry of the uranium plume include (1) the former waste pits that were present in the waste storage area, (2) the former inactive flyash pile that was present in the South Field area, (3) former production activities, and (4) the previously uncontrolled surface water runoff from the former production area that had direct access to the aquifer through a former drainage originating near the Plant 1 pad and flowing west through the former waste storage area and the Pilot Plant drainage ditch.

A groundwater remediation strategy that relies on pump-and-treat technology is being used to conduct a concentration-based cleanup of the Great Miami Aquifer. The restoration strategy focuses primarily on the removal of uranium, but it has also been designed to limit the farther expansion of the plume, remove targeted contaminants to concentrations below designated FRLs, and prevent undesirable drawdown impacts beyond the Fernald Preserve.

The aquifer's "remediation footprint" is a term used to define those areas of the aquifer that will be targeted for remediation. The OU5 ROD establishes that "areas of the Great Miami Aquifer exceeding FRLs will be restored through extraction methods." Over the course of the aquifer remedy, the areas of the aquifer being targeted for restoration have changed due to:

- The collection of additional characterization data to support modular designs.
- Changing the uranium FRL concentration for groundwater from 20 µg/L to 30 µg/L.

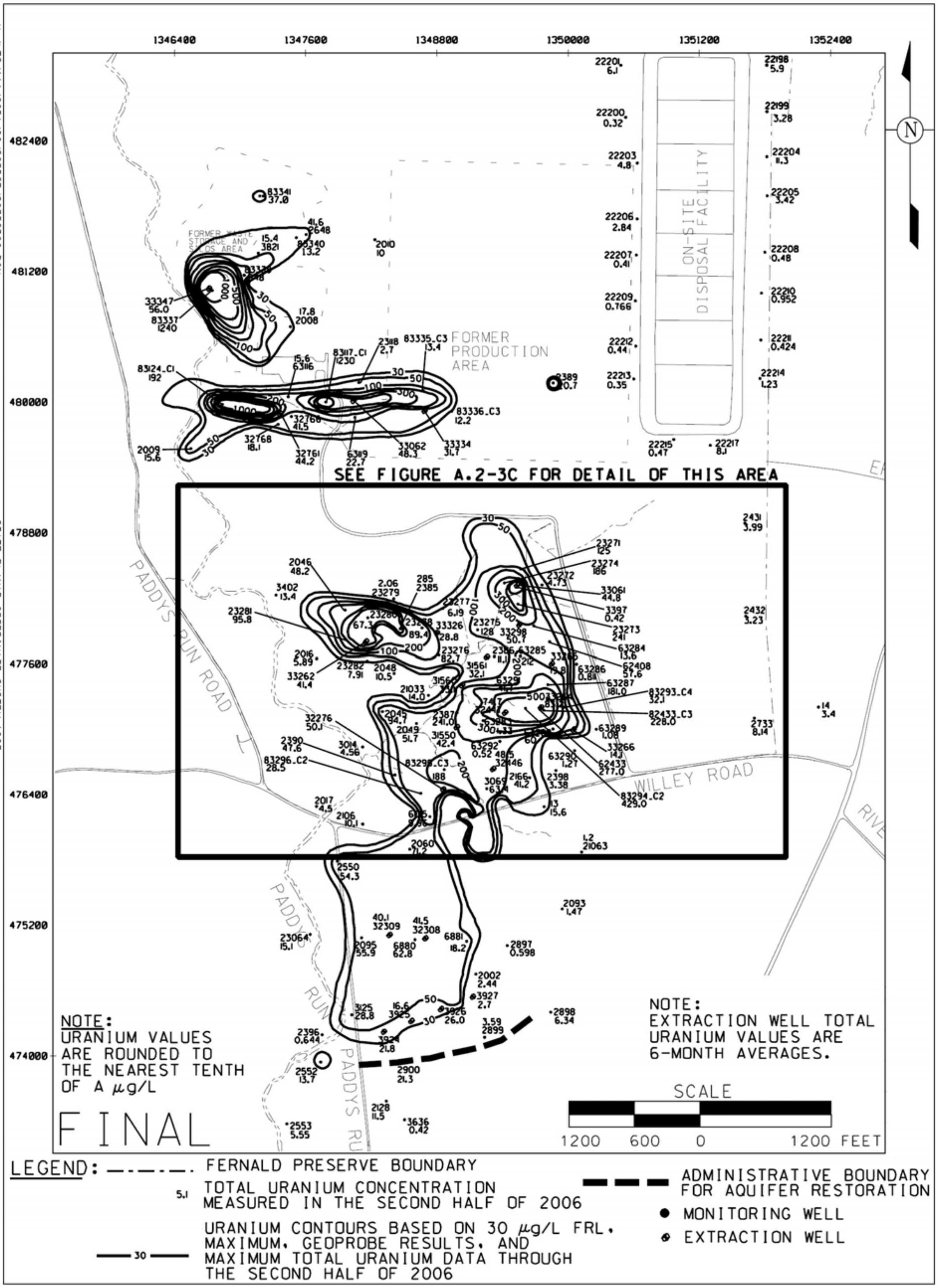

Figure 3–2a. Monitoring Well Data and Maximum Total Uranium Plume in South Field through the Second Half of 2006

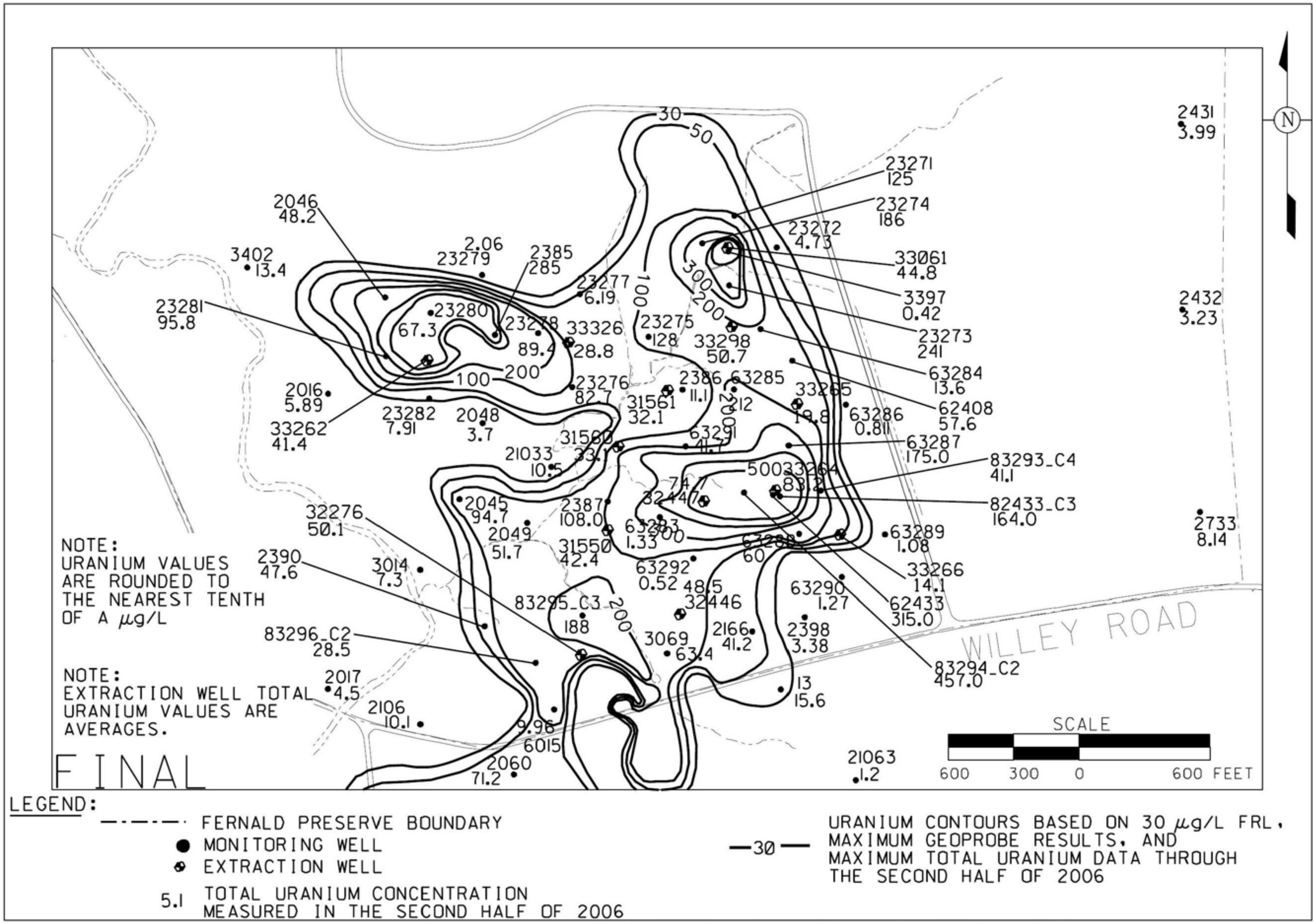

Figure 3–2b. Monitoring Well Data and Maximum Total Uranium Plume through the Second Half of 2006

Following is a brief discussion of the changes, along with information on the remediation footprint:

- Continued groundwater monitoring and direct-push sampling conducted to support the design of individual aquifer modules provided data that indicated the area of the aquifer exceeding the groundwater FRL for uranium was larger than the area defined in the OU5 ROD.
- Changing the FRL concentration for uranium in groundwater from 20 µg/L to 30 µg/L decreased the area of the aquifer that was defined as exceeding the groundwater FRL for uranium in the OU5 ROD. In 1996, when the OU5 ROD was signed, the MCL for uranium in drinking water had not been promulgated but was proposed as 20 µg/L. The FRL for uranium for the groundwater remedy was defined as 20 µg/L to match the proposed MCL. In 2001, EPA finalized the MCL for uranium at 30 µg/L for drinking water. Through a ROD Explanation of Significant Differences (ESD), the MCL became the FRL for total uranium in groundwater at the Fernald Preserve.

To incorporate the changes presented above, the remediation footprint of the aquifer is conservatively defined as the areas contained within a composite of all previous 20-µg/L maximum uranium plume interpretations through 2000, and 30-µg/L maximum uranium plume interpretations subsequent to 2000, located north of the Administrative Boundary for aquifer restoration. The remediation footprint of the aquifer (updated through 2006) is shown in Figure 3–3. The interpretation will be updated each year as new data are collected.

Pumping groundwater from the aquifer prior to the start of the actual groundwater remediation began in August 1993 with the startup of five extraction wells in the South Plume. The wells were installed and operated as part of a removal action to prevent the farther southern migration of the uranium plume while the remedial investigation of the plume was being completed and a remediation system was being designed.

The design of the aquifer remediation system has evolved via the issuance of several different design documents. The first aquifer remediation design was presented in the OU5 feasibility study. The design consisted of 28 extraction wells pumping for 27 years. It is this design that is contained in the OU5 ROD. A commitment was made in the OU5 ROD to pursue technological advances that might decrease the remediation time. A technology that was pursued was treated groundwater re-injection. Groundwater modeling was conducted to determine if adding re-injection wells to the remediation would facilitate a quicker cleanup. The groundwater modeling showed that a faster cleanup could be realized by using re-injection if several other actions were also realized. These other actions included:

- Other OUs completing their accelerated cleanup objectives so that surface access is available for aquifer remediation wells.
- The accelerated removal of sources to allow extraction wells to be located closer to the center of uranium plumes.
- Modeled geochemical and hydraulic parameters being consistent with aquifer conditions.

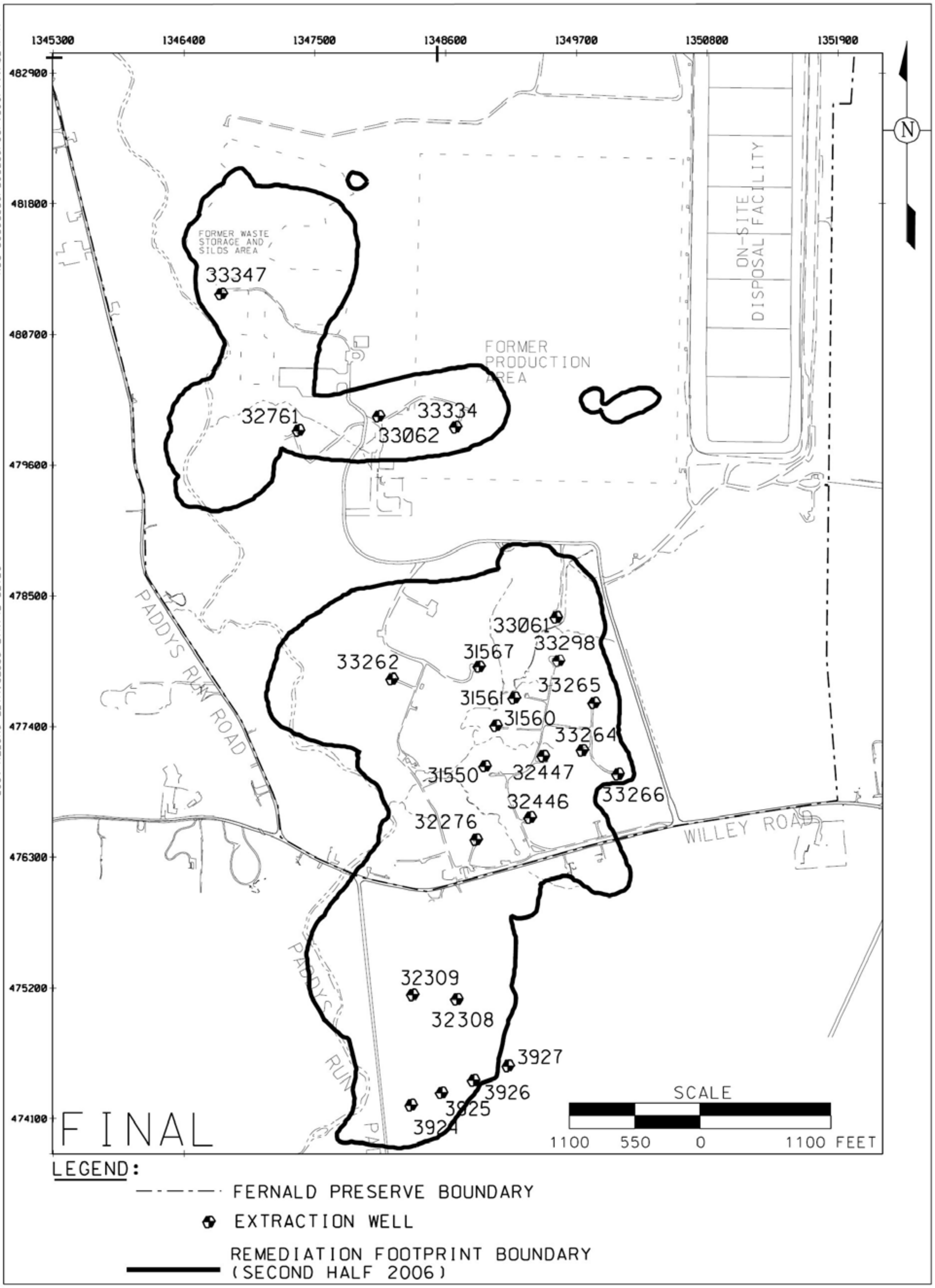

Figure 3–3. Extraction Well Locations

An aquifer remediation design, which included re-injection, was presented in the *Baseline Remedial Strategy Report, Remedial Design for Aquifer Restoration*. This design called for 37 pumping wells and 10 re-injection wells. The predicted cleanup time was modeled at 10 years. The pumping and re-injection wells were subdivided into five area-specific restoration modules:

- The South Plume Module
- The South Field Module
- The Waste Storage Area Module
- The Plant 6 Module
- The Re-Injection Demonstration Module

Although groundwater modeling showed that re-injection expedited the cleanup, the technology was unproven at the Fernald Preserve. Of concern was the cost of keeping the wells operational (industry experience showed that these wells tend to plug). A demonstration was needed to prove that the re-injection wells could be operated efficiently at the Fernald Preserve. The decision was made to tie the demonstration into the remedy design presented in the *Baseline Remedial Strategy Report*. If successful, the impact to the remedy would be immediate.

In the summer of 1998, the first wells for the aquifer remediation became operational and marked implementation of the aquifer remedy design presented in the *Baseline Remedial Strategy Report*. Implementation of the *Baseline Remedial Strategy Report* design included a groundwater re-injection demonstration that was conducted from September 2, 1998, to September 2, 1999. At the request of the Fernald Preserve, the evaluation of re-injection technology at the Fernald Preserve was sponsored by DOE's Office of Science and Technology Subsurface Contaminants Focus Area. The re-injection demonstration was successful, and re-injection was incorporated into the aquifer remedy.

Changes to the aquifer remedy design for the Waste Storage Area and Plant 6 modules were implemented in 2002 based on findings and groundwater modeling results presented in the *Conceptual Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas*. Characterization efforts conducted in support of the design showed that the uranium plume in the Plant 6 area had dissipated, eliminating the need for extraction wells there. Therefore, an aquifer restoration module was not installed in the Plant 6 area; however, groundwater monitoring in the Plant 6 area will continue (at Monitoring Well 2389) until the Waste Storage Area Module, which is upgradient of the Plant 6 area, has been certified clean.

Characterization efforts conducted in support of the waste storage area design also showed that the uranium plume in the waste storage area was smaller than what was characterized during the RI/FS, and that the waste storage area uranium plume in the vicinity of the confluence of Paddys Run and the Pilot Plant drainage ditch needed to be redefined and extended to the east. In light of these findings, a new restoration module for the waste storage area was modeled and designed. The number of wells needed in the design to remediate the waste storage area went from 10 (*Baseline Remedial Strategy Report* design) down to five (modified module design). The details concerning this design are presented in the *Design for Remediation of the Great Miami*

Aquifer in the Waste Storage and Plant 6 Areas (DOE 2001b). Three of the extraction wells began pumping in 2002.

Changes to the aquifer remedy design for the South Field Module were implemented in 2003 based on findings presented in the *Design for Remediation of the Great Miami Aquifer, South Field (Phase II) Module*. Characterization efforts conducted to support the design showed that uranium concentrations beneath western portions of the Southern Waste Units were much lower than in previous years. The lower concentrations were attributed to source removal, the natural flow of clean groundwater from the west into the area, the continued flushing of clean recharge water through Paddys Run to the underlying aquifer, the increased flushing of clean recharge water through deep surface excavations in the inactive flyash pile, and the remedial pumping of the extraction wells to the east of this area. The modified design for Phase II of the South Field Module went from nine new extraction wells and five new re-injection wells (*Baseline Remedial Strategy Report* design) down to four new extraction wells, one new re-injection well, the conversion of an existing extraction well into an injection well, and an injection basin (modified module design).

In 2004, aquifer remedy design changes were implemented to address changing water treatment needs resulting from site closure and to stop well-based re-injection. Several water treatment flows were eliminated or reduced (e.g., remediation wastewater, sanitary wastewater, storm water runoff) from the scope of the treatment operation. Elimination or reduction of these flow streams provided an opportunity to reduce the size of the water treatment facility remaining to service the aquifer restoration after site closure. Reducing the size of the treatment facility prior to site closure in 2006 reduced the amount of impacted materials that will be sent for off-site disposal after closure.

Groundwater modeling presented in the *Comprehensive Groundwater Strategy Report* (DOE 2003b) predicted that continued use of large-scale re-injection using existing re-injection wells would shorten the aquifer remedy by 3 years (comparison of Alternatives 1 and 6). These results indicated limited benefit to maintaining the infrastructure for large-scale, well-based re-injection (when viewed in relation to water treatment facility scale-down activities) and supported the decision to stop re-injection. Therefore, the decision was also made in 2004 not to restart well-based re-injection once the CAWWT was operational.

The last aquifer module design for the groundwater remedy was completed in 2005. The *Waste Storage Area Phase II Design Report* was issued in June of 2005 (DOE 2005b). Aquifer characterization data collected in support of the Phase II design revealed that uranium concentrations in the aquifer near the former silos area were higher than what was previously mapped, but that the footprint of the uranium plume was smaller than what was previously mapped. Non-uranium FRL exceedances included technetium-99, nitrate/nitrite, nickel, carbon disulfide, trichloroethene, molybdenum, and manganese. With the exception of manganese, these non-uranium FRL exceedances were within or very near the footprint of the uranium plume. The footprint of the manganese plume was larger than the footprint of the uranium plume, and biofouling was suspected at some of the monitoring wells where the highest manganese concentrations were detected.

Follow-up work was conducted to determine if manganese might be bioaccumulating around the well screens of some of the monitoring wells in the Waste Storage Area, and to also remodel the cleanup of the manganese plume using a manganese K_d value that was representative of the

Great Miami Aquifer at the Fernald Preserve. Results of the follow-up work were presented in the *Addendum to the Waste Storage Area (Phase II) Design Report* (DOE 2005c), which was issued in a comment response package on December 6, 2005. The follow-up work concluded that manganese was bioaccumulating around some of the monitoring wells. Modeled predicted cleanup of the manganese plume (using a K_d of 1.3 L/kg) indicated that the manganese plume would be cleaned up considerably faster than the uranium plume using the Phase II design (one additional extraction well).

A test was conducted in 2005 to gauge seasonal flow of water in the Storm Sewer Outfall ditch (SSOD) and to determine if recharge to the Great Miami Aquifer through the SSOD at a rate of 500 gallons per minute (gpm) was feasible (DOE 2005d). As reported in the *Groundwater Remedy Evaluation and Field Verification Plan* (DOE 2004), infiltration through the SSOD at a rate of 500 gpm was predicted to decrease the cleanup time by 1 year. The study concluded, though, that the operation would not be cost effective. Subsequent discussions with EPA and OEPA in 2006 led to an agreement to proceed with a scaled-down version of the operation. Clean groundwater is being pumped into the SSOD to supplement natural storm water runoff in an attempt to accelerate remediation of the South Plume. Three existing wells on the east side of the site are being utilized to deliver as much clean groundwater as is needed to maintain a flow of approximately 500 gpm into the SSOD. This supplemental pumping will continue until the existing wells, pumps, or motors are no longer serviceable. At that time, the operation will be suspended, pending a determination that the remedy is benefiting from the operation.

3.4.2.2 The Modular Approach to Aquifer Restoration

Restoration of the Great Miami Aquifer is being accomplished by using three area-specific groundwater restoration modules (South Plume Module, South Field Module, and Waste Storage Area Module) and a centralized water treatment facility (Figure 3–1). Figure 3–3 shows the location of the extraction wells that comprise these modules.

<u>South Plume Module</u>
Six extraction wells (3924, 3925, 3926, 3927, 32308, and 32309) are operating in the South Plume Module. Extraction Wells 3924, 3925, 3926, and 3927, which were originally called the South Plume Module, have been in operation since 1993 as part of a removal action. Located at the southern edge of the total uranium plume, the initial South Plume Module, as reported in the Work Plan for the South Contaminated Plume Removal Action (DOE 1992), was installed to create a hydraulic barrier and to prevent further southern migration of the uranium plume. In 1998, two additional extraction wells (32308 and 32309) became operational just north of the four original South Plume Module wells. These two wells were installed under a project known as the South Plume Optimization Module. The term “South Plume Module” is used to refer to both the original extraction wells installed under the South Plume Module and those installed under the South Plume Optimization Module.

<u>South Field Module</u>
Thirteen extraction wells (31550, 31560, 31561, 32276, 32446, 32447, 33061, 33262, 33264, 33265, 33266, 33298, and 33326) are operating in the South Field Module. Restoration of the aquifer in the South Field area began in 1998 when 10 extraction wells (31550, 31560, 31561, 31562, 31563, 31564, 31565, 31566, 31567, and 32276) began pumping around the excavation area near the SSOD ditch (South Field Extraction [Phase I] Module). Six of the original ten extraction wells (31562, 31563, 31564, 31565, 31566, and 31567) are no longer operating:

- Extraction Well 31562 was shut down in 2003 and replaced by a new well (33298).
- Extraction Well 31563 was shut down in 2002 and converted to a re-injection well as part of the South Field (Phase II) project.
- Extraction Wells 31564 and 31565 were shut down in 2001 so that additional soil remediation could be conducted in the area. The decision was made not to re-start pumping at these wells because they are no longer situated in locations that will provide a pumping benefit to the aquifer remedy.
- Extraction Well 31566 was shut down in 1998 to minimize the potential for pulling contamination into a region of the aquifer with finer grain sediment.
- Extraction Well 31567 was shut down in 2005 due to excessive plugging of the well screen; it was replaced by a new well (33326).

The South Field Module was expanded in 1999 and 2002. In 1999, Extraction Wells 32446 and 32447 were added and began operating in 2000. Extraction Well 33061 was added and became operational in 2002. In 2003, the module was modified again, this time as part of Phase II. Four new extraction wells (33262, 33264, 33265, and 33266), one replacement well (33298), two re-injection wells (33263 and 31563), and one injection basin became operational. Because of the decision in 2004 to stop well-based re-injection, the two re-injection wells (33263 and 31563) are no longer operating. Also, the injection basin has become a passive feature in that water is not being actively pumped to the basin. Figure 3–3 shows the location of the extraction wells that are operational.

<u>Waste Storage Area Module</u>
Four extraction wells (32761, 33062, 33334, and 33347) are operating in the Waste Storage Area Module. Two of the extraction wells (32761 and 33062) were installed as part of the Waste Storage Area (Phase I) Module. A third extraction well (33063) installed as part of the Waste Storage Area (Phase I) Module was plugged and abandoned in 2004 to facilitate surface excavation activities. A replacement well (33334) has been installed. Extraction Well 33347 is part of the Waste Storage Area (Phase II) design. It became operational in 2006.

The groundwater monitoring program is designed to track remedy performance of the modules presented above. For monitoring purposes, the aquifer is divided into five zones referred to as “aquifer zones” (refer to Figure 3–4). These aquifer zones are used to evaluate the predicted performance (both individually and collectively) at the aquifer restoration modules. Aquifer Zones 1, 2, and 4 contain aquifer remediation modules. Aquifer Zone 0 (the fifth zone) is the area outside the other four aquifer zones.

The locations of the extraction wells comprising the restoration modules are as follows:

- The South Plume Module is located in Aquifer Zone 4.
- The South Field Module (Phases I and II) is located in Aquifer Zone 2.
- The Waste Storage Area Module (Phases I and II) is located in Aquifer Zone 1.

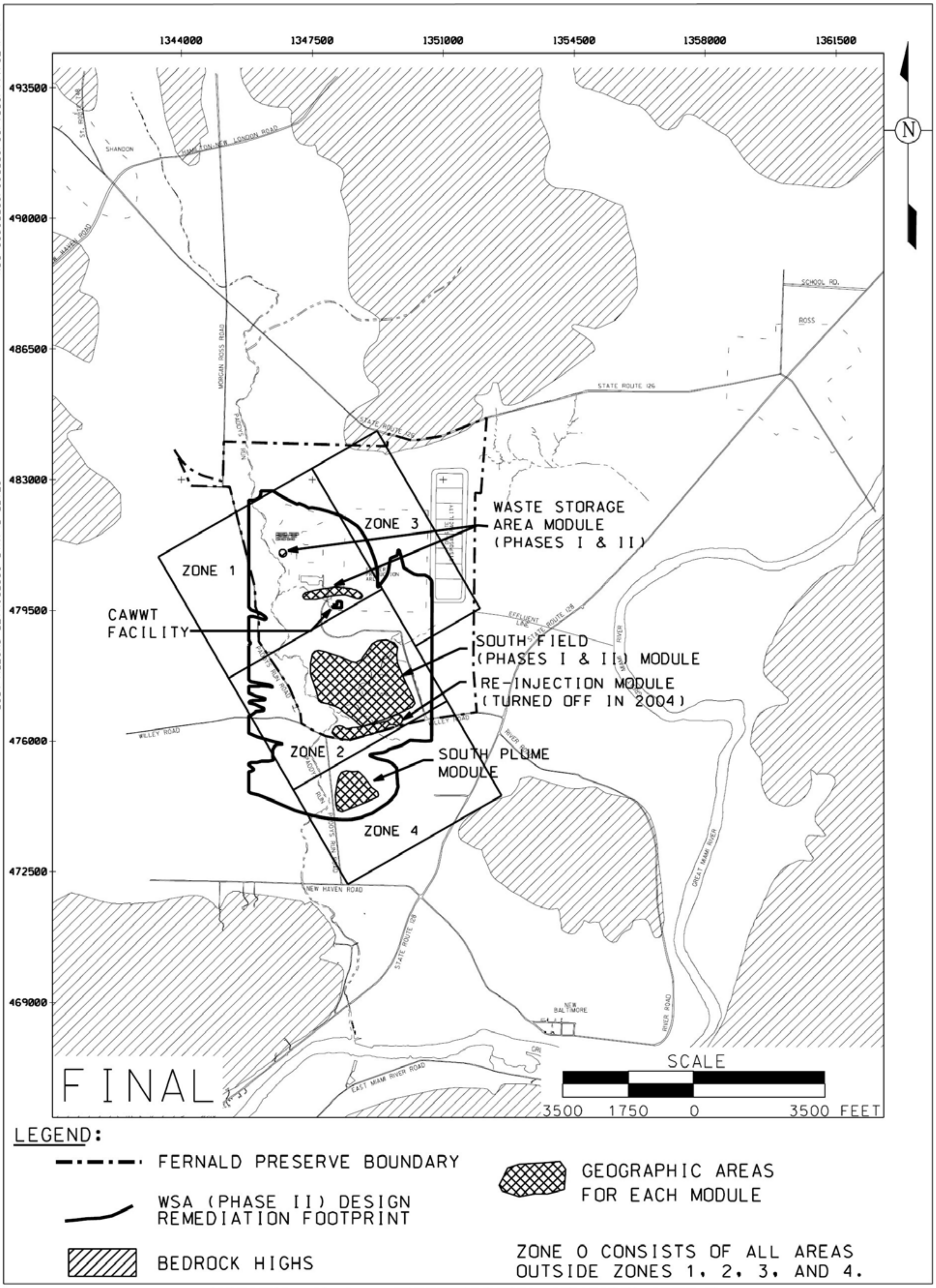

Figure 3–4. Groundwater Aquifer Zones and Aquifer Restoration Footprint

Ten-year, reverse particle path modeling predicts a hydraulic capture zone that is larger than the actual dimension of the 30-µg/L total uranium plume. In previous plans, the extent of this capture zone was called the 10-year, uranium-based restoration footprint. The 10-year time reference originated from the 1997 modeling done for the *Baseline Remedial Strategy Report* that predicted a 10-year cleanup time. As discussed earlier, the current Waste Storage Area (Phase II) design is modified from the *Baseline Remedial Strategy Report* design; therefore, the 10-year aquifer restoration footprint originating from the *Baseline Remedial Strategy Report* is no longer applicable to the remedy. The 10-year time of travel remediation footprint presented in this plan (see Figure 3–4) is based on the Waste Storage Area (Phase II) design (2007 through 2023). This design remediation footprint was constructed using reverse, non-retarded, particle-path interpretations from the VAM3D Groundwater Model. The limits of most of the particle tracks are truncated because the particles reached the edge of the Zoom groundwater model domain.

3.4.2.3 Well Selection Criteria

Geologic and hydrogeologic properties, predicted and actual groundwater flow, and contaminant distribution within the Great Miami Aquifer (before and during remediation) serve as input to the design and modification of the IEMP groundwater monitoring network. Field measurements and computer simulations were conducted to support initial design efforts.

All available information is reviewed to select appropriate monitoring well locations. The monitoring well locations for the IEMP are selected according to the following criteria:

- Monitor within the projected capture zone of the groundwater restoration operation unless an operational concern (e.g., the close proximity of the South Plume extraction wells to the PRRS plume) requires a monitoring location to be outside of the capture zone. Note: Pumping rates may change to optimize the operation through time; therefore, the capture zone may also change.
- Use existing monitoring wells in the remediation footprint of the aquifer and avoid installing new monitoring wells unless determined necessary based on operational knowledge, which will be used to help select new locations.
- Provide adequate areal coverage across each remediation module area.
- Include monitoring wells that are needed to meet site-specific monitoring commitments.
- Select monitoring well locations that will provide data needed to determine how reasonable model predictions are over the long term.
- Select monitoring well locations in consideration of landowner concerns. In the off-property portion of the South Plume, landowner access concerns have, and will continue to have, a bearing on the location and number of monitoring wells in that area. Generally, location of monitoring wells is limited to peripheral areas along the edges of the farm fields. This monitoring well limitation is being addressed through supplemental use of direct push sampling that can be conducted during the times of the year when the fields are not being used for crops.

Approximately 140 wells at the Fernald Preserve are being sampled as identified in the subsections that follow.

3.4.2.4 Constituent Selection Criteria

The groundwater sampling constituent selection criteria are based on evaluation of the groundwater data that have been collected since the inception of the IEMP. Rationale and information concerning constituent selection is presented in Appendix A. Following is an overview.

Restoration of the aquifer will be verified against FRLs. FRLs for the aquifer have been established in the OU5 ROD for 50 COCs. Groundwater monitoring focuses on these 50 FRL constituents to assess the progress of the aquifer remedy.

As presented in Appendix A, a short list of constituents has been established for monitoring purposes and is based on where and whether constituents have had FRL exceedances in the aquifer since the inception of the IEMP. Constituents on the short list are monitored semiannually. Monitoring of those constituents not on the short list will be addressed during Stage III (Certification/Attainment Monitoring), as necessary.

Table 3–2 summarizes groundwater sampling results since the inception of the IEMP program and contains the following information:

- Column 1 lists the 50 constituents for which FRLs were established in the OU5 ROD.
- Column 2 lists the respective FRL concentration for each of the constituents.
- Column 3 identifies the basis for each FRL constituent (i.e., risk, ARAR, background, or detection limit) as defined in the OU5 Feasibility Study Report.
- Column 4 documents the number of samples that have been analyzed for each constituent since the start of IEMP sampling.
- Column 5 notes the number of samples that have had a concentration greater than the FRL for each constituent.
- Column 6 notes the percent of the samples for each constituent that have had a concentration greater than the FRL.
- Column 7 identifies the zones where FRL exceedances have been observed and the number of wells in each zone that had exceedances.
- Column 8 shows the above FRL concentration range for each constituent that had FRL exceedances.

As shown in Table 3–2, 35 of the 50 groundwater FRL constituents have not had an FRL exceedance. Excluding uranium, the groundwater FRL constituents that did have recorded exceedances were from a limited number of wells. The spatial distribution of these wells indicates that many of the non-uranium FRL exceedances are not associated with a plume.

Table 3–2. Groundwater FRL Exceedances Based on Samples and Locations Since IEMP Inception (from August 1997 through 2006)

(1) Constituent	(2) Groundwater FRL[a]	(3) Basis for FRL[b]	(4) No. of Samples[c]	(5) No. of Samples >FRL[c,d]	(6) Percent of Samples >FRL	(7) Zones with FRL Exceedances (No. of Wells with exceedances in each Aquifer Zone)[c,d,e]	(8) Range above FRL[c,d,e]
Uranium, Total	30 µg/L	A	4538	1155	25.45%	1(19) 2(38) 3(3) 4(16)	30.13 J/1240 NV
Zinc	0.021 mg/L	B	1267	81	6.39%	0(10) 1(5) 2(14) 3(5) 4(2)	0.0212 NV/13.6 -
Manganese	0.90 mg/L	B	1479	96	6.49%	0(5) 1(6) 2(10) 3(5) 4(4)	0.916 -/105 J
Nickel	0.10 mg/L	A	1301	20	1.54%	0(1) 1(1) 2(7) 3(1)	0.101 -/1.54 -
Technetium-99	94 pCi/L	R*	1532	35	2.28%	1(3)	101.08 -/1352.266 J
Nitrate[f]	11 mg/L	B	1923	38	1.98%	1(5) 2(1)[g]	11.4 -/331 NV
Lead	0.015 mg/L	A	1276	13	1.09%	0(2) 1(2) 2(4) 3(2)	0.0157 -/0.201 -
Arsenic	0.050 mg/L	A	1494	14	0.94%	0(1) 1(1) 2(1) 4(4)	0.051 -/0.125 -
Molybdenum	0.10 mg/L	A	835	13	1.56%	1(1)	0.207 -/0.69 -
Boron	0.33 mg/L	R	2065	15	0.73%	2(2)	0.331 -/1.16 -
Antimony	0.0060 mg/L	A	1277	9	0.70%	0(4) 1(1) 2(2)4(1)	0.00601 -/0.0196 J
Trichloroethene	0.0050 mg/L	A	1392	13	0.93%	1(2)	0.0207 -/0.120 -
Carbon disulfide	0.0055 mg/L	A	1023	6	0.59%	0(1)[h] 1(3) 2(1)[h]	0.006 -/0.014 -
Fluoride	4 mg/L	A	1497	4	0.27%	0(2) 1(1) 3(1)	5.3 -/12.3 -
Vanadium	0.038 mg/L	R	951	1	0.11%	0(1)	0.0664 J[i]
1,1-Dichloroethane	0.28 mg/L	A	86	0	0%	NA	NA
1,1-Dichloroethene	0.0070 mg/L	A	565	0	0%	NA	NA
1,2-Dichloroethane	0.0050 mg/L	A	704	0	0%	NA	NA
2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.000010 mg/L	D	19	0	0%	NA	NA
4-Methylphenol	0.029 mg/L	R	86	0	0%	NA	NA
4-Nitrophenol	0.32 mg/L	R	86	0	0%	NA	NA
alpha-Chlordane	0.0020 mg/L	A	772	0	0%	NA	NA
Aroclor-1254	0.00020 mg/L	D	86	0	0%	NA	NA
Barium	2.0 mg/L	A	194	0	0%	NA	NA
Benzene	0.0050 mg/L	A	947	0	0%	NA	NA
Beryllium	0.0040 mg/L	A	877	0	0%	NA	NA
bis(2-Chloroisopropyl) ether	0.0050 mg/L	D	459	0	0%	NA	NA
bis(2-Ethylhexyl)phthalate	0.0060 mg/L	A	86	0[j]	0%	NA[j]	NA
Bromodichloromethane	0.10 mg/L	A	771	0	0%	NA	NA
Bromomethane	0.0021 mg/L	R	86	0	0%	NA	NA
Cadmium	0.014 mg/L	B	994	0	0%	NA	NA

Table 3–2. Groundwater FRL Exceedances Based on Samples and Locations Since IEMP Inception (from August 1997 through 2006) (continued)

(1) Constituents	(2) Groundwater FRL[a]	(3) Basis for FRL[b]	(4) No. of Samples[c]	(5) No. of Samples >FRL[c,d]	(6) Percent of Samples >FRL	(7) Zones with FRL Exceedances (No. of Wells with exceedances in each Aquifer Zone)[c,d,e]	(8) Range above FRL[c,d,e]
Carbazole	0.011 mg/L	R	459	0	0%	NA	NA
Chloroethane	0.0010 mg/L	D	86	0	0%	NA	NA
Chloroform	0.10 mg/L	A	86	0	0%	NA	NA
Chromium VI	0.022 mg/L	R	16	0	0%	NA	NA
Cobalt	0.17 mg/L	R	878	0	0%	NA	NA
Copper	1.3 mg/L	A	86	0	0%	NA	NA
Mercury	0.0020 mg/L	A	2112	0[k]	0%	NA	NA
Methylene chloride	0.0050 mg/L	A	84	0	0%	NA	NA
Neptunium-237	1.0 pCi/L	R*	1606	0	0%	NA	NA
Octachlorodibenzo-p-dioxin	1.0E-7 mg/L	D	19	0	0%	NA	NA
Radium-226	20 pCi/L	A	194	0	0%	NA	NA
Radium-228	20 pCi/L	A	86	0	0%	NA	NA
Selenium	0.050 mg/L	A	991	0	0%	NA	NA
Silver	0.050 mg/L	A	856	0	0%	NA	NA
Strontium-90	8.0 pCi/L	A	1394	0	0%	NA	NA
Thorium-228	4.0 pCi/L	R*	992	0	0%	NA	NA
Thorium-230	15 pCi/L	R*	86	0	0%	NA	NA
Thorium-232	1.2 pCi/L	R*	902	0	0%	NA	NA
Vinyl chloride	0.0020 mg/L	A	771	0	0%	NA	NA

[a]From OU5 ROD, Table 9–4.
[b]From OU5 Feasibility Study, Table 2–16:
A = ARAR-based
B = Based on 95th percentile background concentrations
D = Based on lowest achievable detection limit
R = Risk-based Preliminary Remediation Goal (PRG)
R* = Risk-based Preliminary Remediation Level includes the radionuclide risk-based PRG plus its 95th percentile background concentration.
[c]Based on filtered and unfiltered samples from the August 1997 through 2006 IEMP groundwater data.
[d]Sample results having a -, J, or NV qualifier were used:
- = result is confident as reported
J = result is quantitatively estimated
NV = result is not validated
[e]NA = not applicable
[f]Nitrate/nitrite results are evaluated with respect to the nitrate FRL.
[g]Since the IEMP inception, there has been only one nitrate/nitrite exceedance at Well 2017 (in 1998) (refer to Figure A–12).
[h]Since the IEMP inception, there has been one isolated exceedance for carbon disulfide at two locations (refer to Figure A–5).
[i]Since the IEMP inception, there has been only one vanadium exceedance at Well 2426 (in 1998) (refer to Figure A–16).
[j]Of the 86 samples analyzed for bis(2-Ethylhexyl)phthalate, a common laboratory containment, five had results above the FRL. The FRL results above are all considered suspect due to laboratory analysis issues, laboratory blank and field blank contamination, or field duplicate results being non-detected. The five exceedances are as follows: 0.014J mg/L, Well 2398 and 0.010J mg/L, Well 3390 in Aquifer Zone 2; 0.016J mg/L, Well 2109 in Aquifer Zone 3; and 0.008J mg/L, Well 2125 and 0.13J mg/L, Well 3095 in Aquifer Zone 4.
[k]The mercury exceedance is suspect, due to negative matrix spike/matrix spike duplicate (MS/MSD) recoveries. In fact, the MS/MSD (i.e., spiked samples) results were both extremely below the original sample result.

Groundwater monitoring focuses on the short list of 15 groundwater FRL constituents. The following monitoring will be conducted:

1. Uranium, which is the primary COC and has the greatest number of wells with exceedances, will be monitored semiannually.
2. Constituents that have FRL exceedances in multiple zones (i.e., antimony, arsenic, fluoride, lead, manganese, nickel, and zinc) will be monitored semiannually as follows:

   - At a minimum, all constituents will be monitored at downgradient wells including existing property boundary/OSDF wells along the eastern perimeter of the site and those wells along the eastern/southern boundary of the South Plume. Area C on Figure A–19 shows the configuration of this monitoring network, which lies in Zones 0, 2, 3, and 4, and for the most part outside of the restoration footprint. Monitoring at these locations will document that above-FRL contaminants are not migrating beyond the expected capture zone.

     Note: Carbon disulfide and nitrate/nitrite are considered to have legitimate exceedances in only one zone (Zone 1) and are discussed below (refer to item #3).

   - In addition to being monitored in Zones 0, 2, 3, and 4, constituents that have exceedances in multiple zones were evaluated with respect to Zone 1 to determine if monitoring is conducted to address consistent/recent exceedances in this area. Monitoring will be addressed in this zone, in addition to the monitoring at the Property/Plume Boundary, to ensure that the constituents exhibiting consistent/recent exceedances are being monitored near potential sources. From review of Table A–2 (in Appendix A), manganese in Zone 1 appears to have consistent/recent exceedances. Therefore, it will be monitored in this zone at wells that have exceedances. In addition to manganese, nickel had an exceedance in 2002. Nickel will also be monitored in Zone 1. Refer to Area A on Figure A–19 for the locations to be monitored in Zone 1.
3. Constituents that have FRL exceedances in only one zone will be monitored semiannually solely in that zone. The monitoring will consist of the following: carbon disulfide, molybdenum, nitrate/nitrite, technetium-99, and trichloroethene in Zone 1 (waste storage area), and boron in Zone 2 (South Field). Specific monitoring locations will be based on the wells that have exceedances.

   Note: Carbon disulfide has exceedances primarily in Zone 1. The two wells that have exceedances outside Zone 1 were Property Boundary Wells 2432 and 3069. These wells were sampled quarterly and exceedances were slightly above the FRL (6 µg/L with respect to the 5.5 µg/L FRL). For Well 2432, there have been no additional exceedances since the occurrence during first quarter 1999. With regard to the one exceedance for Well 3069 that occurred during fourth quarter 2001, a duplicate result during the sampling event was below the FRL (Figure A–5). No additional exceedances for carbon disulfide have occurred at Well 3069 since 2001.

   Nitrate/nitrite has exceedances primarily in Zone 1. One well (2017), which is located in Zone 2, had a one-time exceedance in 1998.

4. Vanadium has a one-time exceedance in 1998 during quarterly sampling at one well (2426). This constituent will be monitored less than semiannually due to the lack of exceedances. Monitoring for this constituent is addressed in Section A.3.2. Vanadium will be addressed during Stage III (Certification/Attainment Monitoring).

Based on the above four criteria, 13 non-uranium groundwater FRL constituents are on the short list and are monitored semiannually (Table 3–3).

3.5 Design of the IEMP Groundwater Monitoring Program

Monitoring focuses on IEMP data and specifically calls for semiannual monitoring of groundwater FRL constituents with exceedances. A list of IEMP groundwater monitoring wells is provided in Table 3–4. Table 3–5 provides a list of the monitoring requirements. Justification for the monitoring approach is provided in Appendix A.

The monitoring strategy and technical approach will be revised as necessary in subsequent revisions to the IEMP to encompass operational changes over the life of the remedy. A startup monitoring, project-specific plan or variance to an existing plan will be developed to supplement the IEMP each time a new extraction well begins to operate for the first time.

3.6 Medium-Specific Plan for Groundwater Monitoring

This section serves as the medium-specific plan for implementation of the sampling, analysis, and data-management activities associated with the site-wide groundwater remedy performance monitoring program. The program expectations and design presented in Section 3.4 were used as the framework for developing the monitoring approach presented in this section. The activities described in this medium-specific plan have been designed to provide groundwater data of sufficient quality to meet the program expectations as defined in Section 3.4.1. All sampling procedures and analytical protocols described or referenced herein are consistent with the requirements of the *Legacy Management CERCLA Sites Quality Assurance Project Plan* (LM QAPP) (DOE 2006c), which references the *Site-Wide CERCLA Quality Assurance Project Plan* (SCQ) (DOE 2003c) as the primary document that describes procedures and protocols for monitoring the Fernald Preserve.

Subsequent sections of this medium-specific plan define the following:

- Project organization and associated responsibilities
- Sampling program
- Change control
- Health and safety
- Data management
- Project quality assurance

Table 3–3. IEMP Constituents with FRL Exceedances, Location of Exceedances, and Revised Monitoring Program

Parameter	Aquifer Zones with Exceedances	Monitoring Program
Antimony	Multiple Zones	Property/Plume Boundary
Arsenic	Multiple Zones	Property/Plume Boundary
Boron	Aquifer Zone 2 (South Field)	South Field
Carbon Disulfide	Aquifer Zone 1 (Waste Storage Area)	Waste Storage Area
Fluoride	Multiple Zones	Property/Plume Boundary
Lead	Multiple Zones	Property/Plume Boundary
Manganese	Multiple Zones[a]	Property/Plume Boundary, Waste Storage Area
Molybdenum	Aquifer Zone 1 (Waste Storage Area)	Waste Storage Area
Nickel	Multiple Zones	Property/Plume Boundary, Waste Storage Area
Nitrate/Nitrite	Aquifer Zone 1 (Waste Storage Area)	Waste Storage Area
Technetium-99	Aquifer Zone 1 (Waste Storage Area)	Waste Storage Area
Trichloroethene	Aquifer Zone 1 (Waste Storage Area)	Waste Storage Area
Zinc	Multiple Zones	Property/Plume Boundary

[a]There are consistent/recent exceedances of manganese in Zone 1; therefore, this constituent will be monitored in the waste storage area and along the Property/Plume Boundary.

Table 3–4. List of IEMP Groundwater Monitoring Wells[a]

		Property/Plume Boundary Monitoring				South Field
Number[a]	Total Uranium Monitoring	Monitor FRL Exceedances	Monitor OSDF Constituents[b]	Monitor PRRS Constituents[c]	Waste Storage Area Monitoring - FRL Exceedances	Monitoring - FRL Exceedances
1	13					
2	14					
3	2002					
4	2008					
5	2009					
6	2010				2010	
7	2014					
8	2016					
9	2017					
10	2045					2045
11	2046					
12	2048					
13	2049					2049
14	2060 (12)					
15	2093	2093				
16	2095					
17	2106					
18	2125					
19	2128	2128		2128		
20	2166					
21	2385					

Table 3–4. List of IEMP Groundwater Monitoring Wells (continued)

Number[a]	Total Uranium Monitoring	Property/Plume Boundary Monitoring: Monitor FRL Exceedances	Property/Plume Boundary Monitoring: Monitor OSDF Constituents[b]	Property/Plume Boundary Monitoring: Monitor PRRS Constituents[c]	Waste Storage Area Monitoring - FRL Exceedances	South Field Monitoring - FRL Exceedances
22	2386					
23	2387					
24	2389					
25	2390					
26	2396					
27	2397					
28	2398	2398				
29	2402					
30	2431	2431				
31	2432	2432				
32	2550					
33	2552					
34	2553					
35	2625	2625		2625		
36	2636	2636		2636		
37	2649				2649	
38	2733	2733				
39	2821				2821	
401	2880					
41	2897					
42	2898	2898		2898		
43	2899	2899		2899		
44	2900	2900		2900		
45	3014					
46	3015					
47	3045					
48	3046					
49	3049					
50	3069					
51	3070	3070				
52	3093	3093				
53	3095					
54	3106					
55	3125					
56	3128	3128		3128		
57	3385					
58	3387					
59	3390					
60	3396					
61	3397					
62	3398	3398				
63	3402					
64	3424	3424				
65	3426	3426				
66	3429	3429				
67	3431	3431				
689	3432	3432				

Table 3–4. List of IEMP Groundwater Monitoring Wells (continued)

		Property/Plume Boundary Monitoring				
Number[a]	Total Uranium Monitoring	Monitor FRL Exceedances	Monitor OSDF Constituents[b]	Monitor PRRS Constituents[c]	Waste Storage Area Monitoring - FRL Exceedances	South Field Monitoring - FRL Exceedances
69	3550					
70	3552					
71	3636	3636		3636		
72	3733	3733				
73	3821				3821	
74	3880					
75	3897					
76	3898	3898		3898		
77	3899	3899		3899		
789	3900	3900		3900		
79	4125					
80	4398	4398				
81	6015					
82	6880					
83	6881					
84	21033					
85	21063	21063				
86	21192					
87	22198	22198	22198			
88	22199	22199	22199			
89	22204	22204	22204			
90	22205	22205	22205			
91	22208	22208	22208			
92	22210	22210	22210			
93	22211	22211	22211			
94	22214	22214	22214			
95	23064					
96	23118					
97	23271					
98	23272					
99	23273					
100	23274					
101	23275					
102	23276					
103	23277					
104	23278					
105	23279					
106	23280					
107	23281					
108	23282					
109	31217	31217				
110	32766					
111	32768					
112	62408					
113	62433					
114	63116					
115	63119					

Table 3–4. List of IEMP Groundwater Monitoring Wells (continued)

		Property/Plume Boundary Monitoring				
Number[a]	Total Uranium Monitoring	Monitor FRL Exceedances	Monitor OSDF Constituents[b]	Monitor PRRS Constituents[c]	Waste Storage Area Monitoring - FRL Exceedances	South Field Monitoring - FRL Exceedances
116	63283					
117	63284					
118	63285					
1190	63286					
120	63287					
121	63288					
122	63289					
123	63290					
124	63291					
125	63292					
126	82433					
127	83117					
128	83124					
129	83293					
130	83294					
131	83295					
132	83296					
133	83335					
134	83336					
135	83337				83337[d]	
136	83338				83338[d]	
137	83339				83339[d]	
138	83340				83340[d]	
139	83341				83341[d]	
140	83346				83346[d]	

[a]The number in Column 1 is used to identify the number of wells in the program. The individual monitoring well identification numbers are provided in Columns 2-7 as appropriate.
[b]List of total uranium monitoring wells and Property/Plume Boundary monitoring wells that overlap with OSDF monitoring wells.
[c]List of total uranium monitoring wells and Property/Plume Boundary monitoring wells that overlap with PRRS monitoring wells.
[d]Volatile organics are not sampled in Type 8 wells.

Table 3–5. Monitoring Requirements

Monitoring Requirements[a]

1. TOTAL URANIUM

2. WASTE STORAGE AREA

General Chemistry	Inorganic	Radionuclide	Organic
Nitrate/Nitrite	Manganese Molybdenum Nickel	Technetium-99 Total Uranium[b]	Carbon Disulfide Trichloroethene

3. SOUTH FIELD

General Chemistry	Inorganic	Radionuclide	Organic
NA[c]	Boron	Total Uranium[b]	NA[c]

4. PROPERTY/PLUME BOUNDARY FOR FRL EXCEEDANCES

General Chemistry	Inorganic	Radionuclide	Organic
Fluoride	Antimony Arsenic Lead Manganese Nickel Zinc	Total Uranium[b]	NA[c]

5. PROPERTY/PLUME BOUNDARY FOR PRRS

General Chemistry	Inorganic	Radionuclide	Organic
Phosphorous	Arsenic[d] Potassium Sodium	NA[c]	Benzene Ethyl benzene Isopropyl benzene Toluene Total xylene

[a]Monitoring will be conducted semiannually.
[b]Total uranium is monitored as part of the site-wide uranium monitoring.
[c]NA = not applicable
[d]Arsenic is also monitored with respect to FRL exceedances as part of the Property/Plume Boundary.

3.6.1 Project Organization

A multi-discipline project organization has been established to effectively implement and manage the project planning, sample collection and analysis, and data-management activities directed in this medium-specific plan. The key positions and associated responsibilities required for successful implementation are as follows:

The project team leader will have full responsibility and authority for the implementation of this medium-specific plan in compliance with all regulatory specifications and site-wide programmatic requirements. Integration and coordination of all medium-specific plan activities defined herein with other project groups are also key responsibilities. All changes to these activities must be approved by the team leader or designee.

Health and safety are the responsibility of all individuals working on this project scope. Qualified health and safety personnel shall participate on the project team to assist in preparing and obtaining all applicable permits. In addition, safety specialists shall periodically review and update the specific health and safety documents and operating procedures, conduct pertinent safety briefings, and assist in evaluating and resolving all safety concerns. All activities will be conducted according to the *Fernald Preserve Safety Plan* (DOE 2006h).

Quality assurance personnel will participate on the project team, as necessary, to review project procedures and activities, ensuring consistency with the requirements of the LM QAPP or other referenced standards, and assist in evaluating and resolving all quality-related concerns.

3.6.2 Sampling Program

The information derived from the groundwater monitoring program should produce a clear understanding of groundwater quality in the Great Miami Aquifer. The groundwater sampling process will be controlled so that collected samples are representative of groundwater quality. All procedures for monitoring well development, sample collection, and shipment will be performed in accordance with directives established in the *Sampling and Analysis Plan for United States Department of Energy Office of Legacy Management Sites* (LM SAP) (DOE 2006d) and the LM QAPP.

3.6.2.1 Total Uranium Monitoring

Approximately 140 monitoring wells will be sampled semiannually for total uranium. Approximately 50 of these wells will be sampled for additional constituents as described in Sections 3.6.2.2 through 3.6.2.4. A list of the wells to be sampled for only total uranium is provided in Table 3–6 and shown in Figure 3–5. The wells extend across all aquifer zones and provide monitoring coverage in all restoration module areas. Figure 3–5 shows the locations of the monitoring wells.

This semiannual total uranium sampling activity will address the following remediation sampling needs:

- The need to interpret changes to the total uranium plume over time due to remediation activities.
- The need to interpret the extent of capture in relation to the total uranium plume.
- The need to interpret the effectiveness of the aquifer remedy in maintaining a hydraulic barrier that limits the further southern migration of the total uranium plume and to document the area of uranium contamination (above 30 μg/L) south of the Administrative Boundary.
- Continued tracking of uranium concentrations at three off-property private monitoring wells.

Up to 27 locations will also be sampled each year for total uranium using a direct-push sampling tool. Direct-push sampling will provide vertical profile concentration data. The vertical profile data will be used to supplement the fixed monitoring well data in order to produce more robust plume interpretations. Exact locations for the direct-push sampling will be selected each year based on monitoring well data, modeling needs, and data-interpretation needs.

Table 3–6. List of Groundwater Wells to Be Sampled for Total Uranium Only

13	3046	23278
14	3049	23279
2002	3069	23280
2008	3095	23281
2009	3106	23282
2014	3125	32766
2016	3385	32768
2017	3387	62408
2046	3390	62433
2048	3396	63116
2060 (12)	3397	63119
2095	3402	63283
2106	3550	63284
2125	3552	63285
2166	3880	63286
2385	3897	63287
2386	4125	63288
2387	6880	63289
2389	6015	63290
2390	6881	63291
2396	21033	63292
2397	21192	82433
2402	23064	83117
2550	23118	83124
2552	23271	83293
2553	23272	83294
2880	23273	83295
2897	23274	83296
3014	23275	83335
3015	23276	83336
3045	23277	

Note: Six of the seven available channels in a Type 8 well (also known as a continuous multi-channel tubing (CMT) well) are available for water quality sampling. The seventh channel is used only for water level measurements. The channel completed in the plume interval with the highest measured uranium concentration will be sampled every 6 months. The other five channels will be sampled once a year to document any changes in the plume concentration profile.

Three private wells (12, 13, and 14) will also be sampled for total uranium. Figure 3–5 shows the location of these three wells (Private Well 12 is also identified as Monitoring Well 2060). Continuing to add to the historical database at these three private-well locations is beneficial for facilitating discussions with area stakeholders on the progress of the aquifer restoration. The three locations are situated immediately downgradient of the Fernald Preserve property boundary.

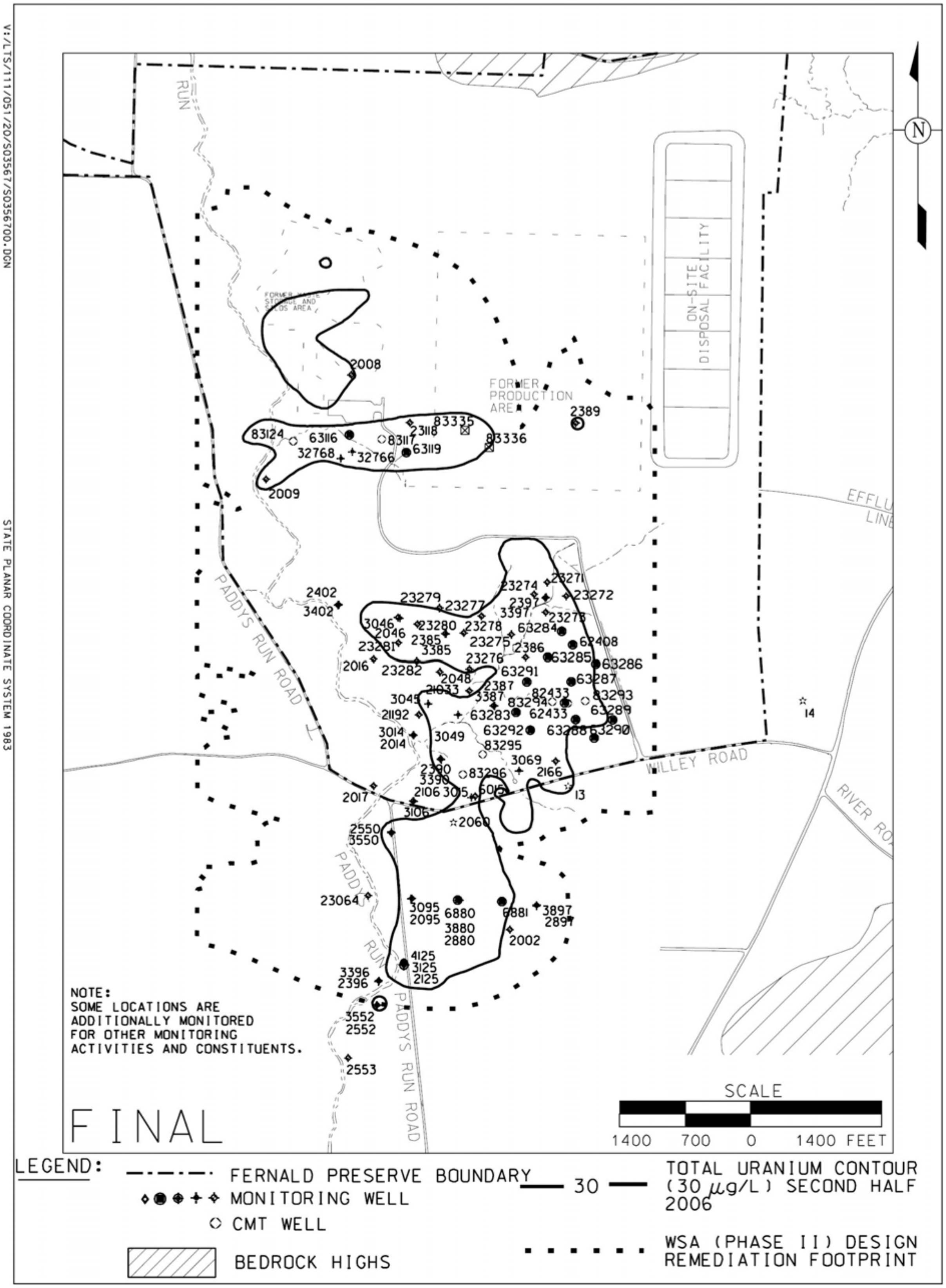

Figure 3–5. Locations for Semiannual Total Uranium Monitoring Only

3.6.2.2 South Field Monitoring

The South Field is located in Aquifer Zone 2 (refer to Figure 3–4). Thirteen extraction wells (South Field [Phases I and II] Module) are operating in the South Field.

In addition to the monitoring wells being sampled in the South Field for total uranium only (refer to Section 3.6.2.1), two monitoring wells (2045 and 2049) will be sampled semiannually for boron and total uranium. The rationale for the selection of these wells and this constituent is presented in Section 3.4 and Appendix A. Figure 3–6 shows the locations of these two wells. Following is the monitoring table:

South Field Monitoring Table
Semiannual Sampling Frequency

General Chemistry	Inorganic	Radionuclide	Organic
NA	Boron	Total Uranium	NA

Direct-push sampling has been conducted annually at five locations (12367, 12368, 12369, 12370, 12371, 12372, and 12373) along and south of Willey Road. These locations have been sampled annually since the re-injection demonstration. Figure 3–7 shows these locations. This annual direct-push sampling will continue at five of the locations in order to track remediation progress. Direct–push sampling at Locations 12367 and 12371 will not continue. These locations are outside of the uranium plume. At each direct-push location, a groundwater sample will be collected at 10-foot intervals beneath the water table and analyzed for only uranium until it can be verified that the entire thickness of the 30-µg/L total uranium plume has been sampled.

3.6.2.3 Waste Storage Area Monitoring

The waste storage area is located in Aquifer Zone 1 (refer to Figure 3–4). Four extraction wells (32761, 33062, 33347, and 33334) are operating in the waste storage area. Figure 3–3 shows the locations of these four wells.

In addition to the monitoring wells being sampled in the waste storage area for total uranium only (refer to Section 3.6.2.1), the 10 wells listed below will be sampled semiannually (refer to Figure 3–6 for the locations of these 10 wells).

Monitoring Wells to Be Monitored Semiannually
in the Waste Storage Area

2010	2649	2821	3821	
83337	83338	83339	83340	83341
83346				

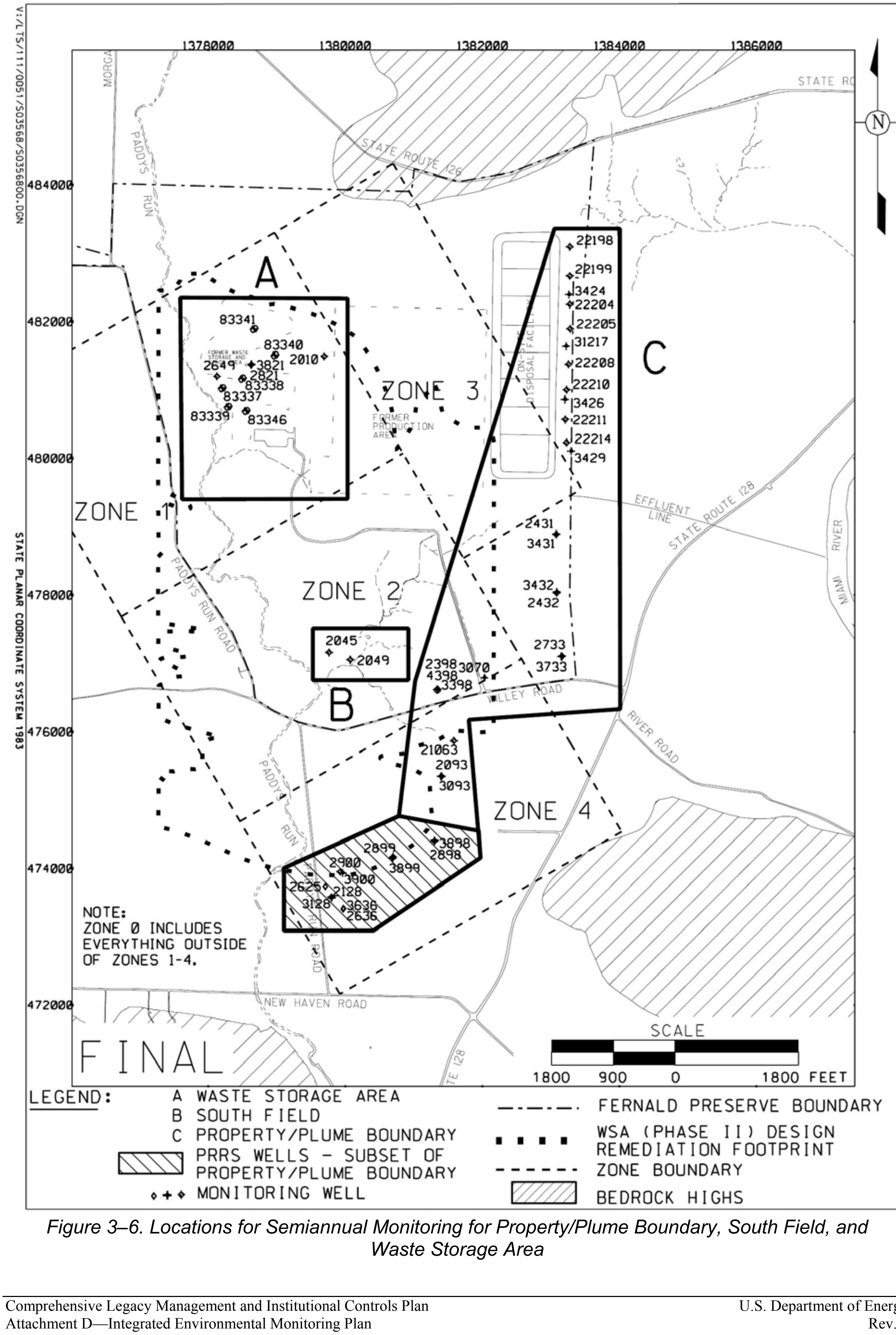

Figure 3–6. Locations for Semiannual Monitoring for Property/Plume Boundary, South Field, and Waste Storage Area

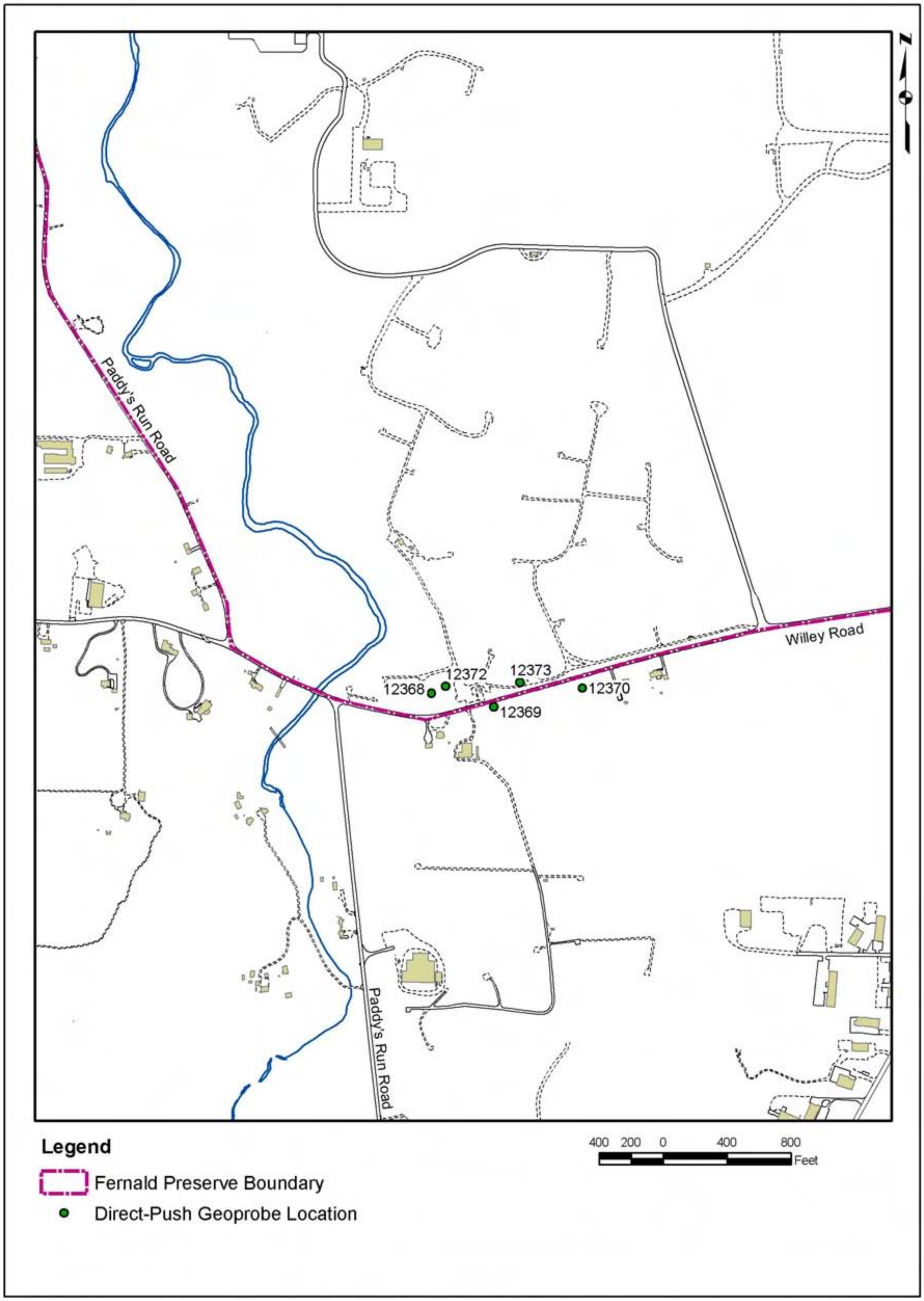

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Figure 3–7. Direct-Push Sampling Locations

The four Type 2 and Type 3 wells will be sampled semiannually for the constituents listed in the table below. The rationale for the selection of these wells and these constituents is presented in Section 3.4 and Appendix A. The six Type 8 wells will also be sampled for the constituents listed in the table below, with the exception of the organics. Type 8 wells will not be used to sample for organics. The six Type 8 wells listed above for the waste storage area are three channel CMT wells. All three channels will be sampled semiannually.

Locations may also be sampled in the waste storage area, utilizing a direct-push sampling tool. Direct-push sampling will provide vertical profile concentration data. The vertical profile data will be used to supplement the fixed monitoring well data in order to produce more robust plume interpretations. Direct-push locations in the waste storage area will be sampled for the waste storage area monitoring semiannual constituents listed below, excluding the organic constituents.

A direct-push sample will be collected prior to any filtering and will be analyzed for nitrate/nitrite. The remainder of the samples (manganese, molybdenum, nickel, total uranium, and technetium-99) will, at a minimum, be filtered through a 5-micron filter. Samples filtered through a 5-micron filter will be identified as "unfiltered" on the Chain-of-Custody.

If the turbidity of the 5-micron filter direct-push sample is below 5-NTUs, the remaining five constituents will be sampled. If the turbidity of the 5-micron filtered direct-push sample is above 5-NTUs, the sample will be further filtered through a 0.45-micron filter. Both the 5-micron and the 0.45-micron filtered sample will be analyzed for total uranium and the four remaining constituents will be analyzed from the 0.45-micron filtered sample only. All samples filtered with a 0.45-micron filter will be identified as "filtered" on the Chain-of-Custody.

Waste Storage Area Monitoring Table
Semiannual Sampling Frequency

General Chemistry	Inorganic	Radionuclide	Organic
Nitrate/Nitrite	Manganese Molybdenum Nickel	Technetium-99 Total Uranium	Carbon Disulfide Trichloroethene

3.6.2.4 Property/Plume Boundary Monitoring

The focus of the Property/Plume Boundary Groundwater Monitoring activity is to detect and assess potential changes in groundwater conditions along the eastern property boundary and downgradient of the leading edge of the 30-µg/L total uranium plume south of the Fernald Preserve property.

Monitoring will be conducted along the property boundary and downgradient uranium plume boundary for FRL exceedances; the influence (or lack of influence) that pumping is having on the PRRS plume will be documented. Monitoring will also reduce redundancy with OSDF monitoring.

Property/Plume Boundary Monitoring for FRL Exceedances

Twenty-five monitoring wells along the eastern property boundary and the leading edge of the off-site total uranium plume will be sampled semiannually (refer to the table that follows). Figure 3–6 is a map showing the locations of the wells.

Property/Plume Boundary Monitoring Wells
To Be Monitored for FRL Exceedances Only

2093	3424	22198
2398	3426	22199
2431	3429	22204
2432	3431	22205
2733	3432	22208
3070	3733	22211
3093	4398	22214
3398	21063	22210
		31217

The 25 monitoring wells will be sampled semiannually for the constituents listed below. All of these constituents have had FRL exceedances. The rationale for the selection of these constituents and the monitoring schedule are presented in Section 3.4 and Appendix A.

Property Plume Boundary Monitoring Table
for FRL Exceedances Semiannual Sampling Frequency

General Chemistry	Inorganic	Radionuclide	Organic
Fluoride	Antimony Arsenic Lead Manganese Nickel Zinc	Total Uranium	NA

Eight of the 25 monitoring wells (22204, 22205, 22208, 22198, 22211, 22214, 22210, and 22199) are also sampled for OSDF constituents.

Property/Plume Boundary Monitoring for Paddys Run Road Site Constituents

Groundwater is being pumped from the aquifer immediately north of the PRRS (Extraction Wells 3924, 3925, 3926, and 3927); it remains important to document the influence (of lack of influence) that the pumping has on the PRRS plume. Groundwater samples will be collected semiannually from 11 monitoring wells (refer to Figure 3–6).

The 11 wells are:

2128	2899	3898
2625	2900	3899
2636	3128	3900
2898	3636	

These 11 wells will be analyzed for PRRS constituents as well as for IEMP FRL exceedance constituents. The PRRS constituents listed below are the constituents to be monitored:

Property Plume Boundary Monitoring Table for FRL Exceedances and Paddys Run Road Site Constituents Semiannual Sampling Frequency

General Chemistry	Inorganic	Radionuclide	Organic
Fluoride	Antimony	Total Uranium	Benzene
Phosphorous	Arsenic		Ethyl benzene
	Lead		Isopropyl benzene
	Manganese		Toluene
	Nickel		Total Xylene
	Potassium		
	Sodium		
	Zinc		

If pumping rates of wells in the South Plume Module are increased above rates established in 1998 (maximum pumping rates listed in Table 5–1 of the OMMP under the objective of minimizing the impact to the PRRS plume), then arsenic sampling will be conducted weekly in Monitoring Wells 2128, 2625, 2636, and 2900, and in Extraction Wells 3924 and 3925. The arsenic sampling will be used to determine if the increased pumping rates have adversely impacted the PRRS plume. The weekly sampling will be done for a minimum of 3 weeks after a pumping rate increase; if no changes in arsenic concentration trends are observed, the increased arsenic sampling will be discontinued. Figure 3–6 identifies the locations of these monitoring wells.

3.6.2.5 Monitoring Non-Uranium Groundwater FRL Constituents without IEMP FRL Exceedances

Monitoring for non-uranium groundwater FRL constituents that have not had an FRL exceedance since the inception of the IEMP will be addressed during Stage III (Certification/Attainment Monitoring), as necessary.

3.6.2.6 Routine Water Level Monitoring

The water table in the Great Miami Aquifer and its response to seasonal fluctuations has been well characterized in the Remedial Investigation Report for OU5. Water level data have been routinely collected at the Fernald Preserve since 1988. Water level data are used to evaluate seasonal variations and interpret groundwater flow directions. This is accomplished by preparing hydrographs and maps of the water table in the Great Miami Aquifer. During the remediation phase of the CERCLA process, water levels will be monitored across the site to assess the effects of extraction operations on the water table and flow conditions within the Great Miami Aquifer.

The Great Miami Aquifer is an unconfined aquifer and responds rapidly to recharge events. Data collected at the Fernald Preserve and reported in the OU5 Remedial Investigation Report document that no strong vertical gradients exist in the area of the Fernald Preserve. Water level monitoring will rely mostly on data from Type 2 wells, which will be supplemented as necessary with data from Type 3, Type 6, and Type 8 wells. Type 8 wells will have water level measurements taken in the top and bottom channels. If the top channel is dry, a measurement will be collected from the next deeper channel that is not dry.

Approximately 180 monitoring wells were selected for water level monitoring; they are shown in Figure 3–8 and listed below. Groundwater elevation monitoring locations were selected to provide areal coverage across the Fernald Preserve with an increasing density of wells in areas surrounding active aquifer restoration wells. Groundwater elevations will be measured quarterly in these wells to provide data for construction of water table elevation maps. These maps will be used to interpret the location of flow divides, capture zones, and stagnation zones created by the operation of remediation wells. Additional monitoring wells and more frequent measurement intervals may be used near aquifer remediation modules as they become operational and as sensitive capture zones or stagnation zones are identified, or if unpredicted fluctuations in contaminant concentrations are observed.

3.6.2.7 Sampling Procedures

Sample analysis will be performed either on-site or at off-site contract laboratories, depending on specific analyses required, laboratory capacity, turnaround time, and performance of the laboratory. The laboratories used for analytical testing have been audited to ensure that Department of Energy Consolidated Audit Program (DOECAP) or equivalent process requirements have been met as specified in the *Legacy Management CERCLA Sites Quality Assurance Project Plan* (LM QAPP). These criteria include meeting the requirements for performance evaluation samples, pre-acceptance audits, performance audits, and an internal quality assurance program.

All monitoring wells will be purged and sampled using the guidelines specified in the LM SAP and the LM QAPP, which have been incorporated into the standard operating procedures used for conducting groundwater sampling. Table 3–7 summarizes the field sampling information by analytical constituent groups and includes the analytical support level (ASL), holding time, preservative, container requirement, and analytical method. The volume of purge water to be removed from monitoring and extraction wells is specified in LM SAP.

In 2001, routine filtering of groundwater samples collected at groundwater monitoring wells was initiated. The objective was to collect a representative sample of what was dissolved and mobile in the sample as opposed to what was bound to the sediments then released by the preservative added to the sample during the collection process. A review of 221 analytical results for uranium shows mixed reviews in achieving this objective. Unexpectedly, approximately 27 percent of the filtered uranium results were higher than the unfiltered uranium results. T-test statistics indicate that there is no evidence to suggest that the two sample sets (unfiltered vs. filtered) come from populations having different means. In conclusion, filtering provided inconsistent results and does not appear to have achieved its objective; therefore, routine filtration of groundwater samples collected at monitoring wells will no longer occur.

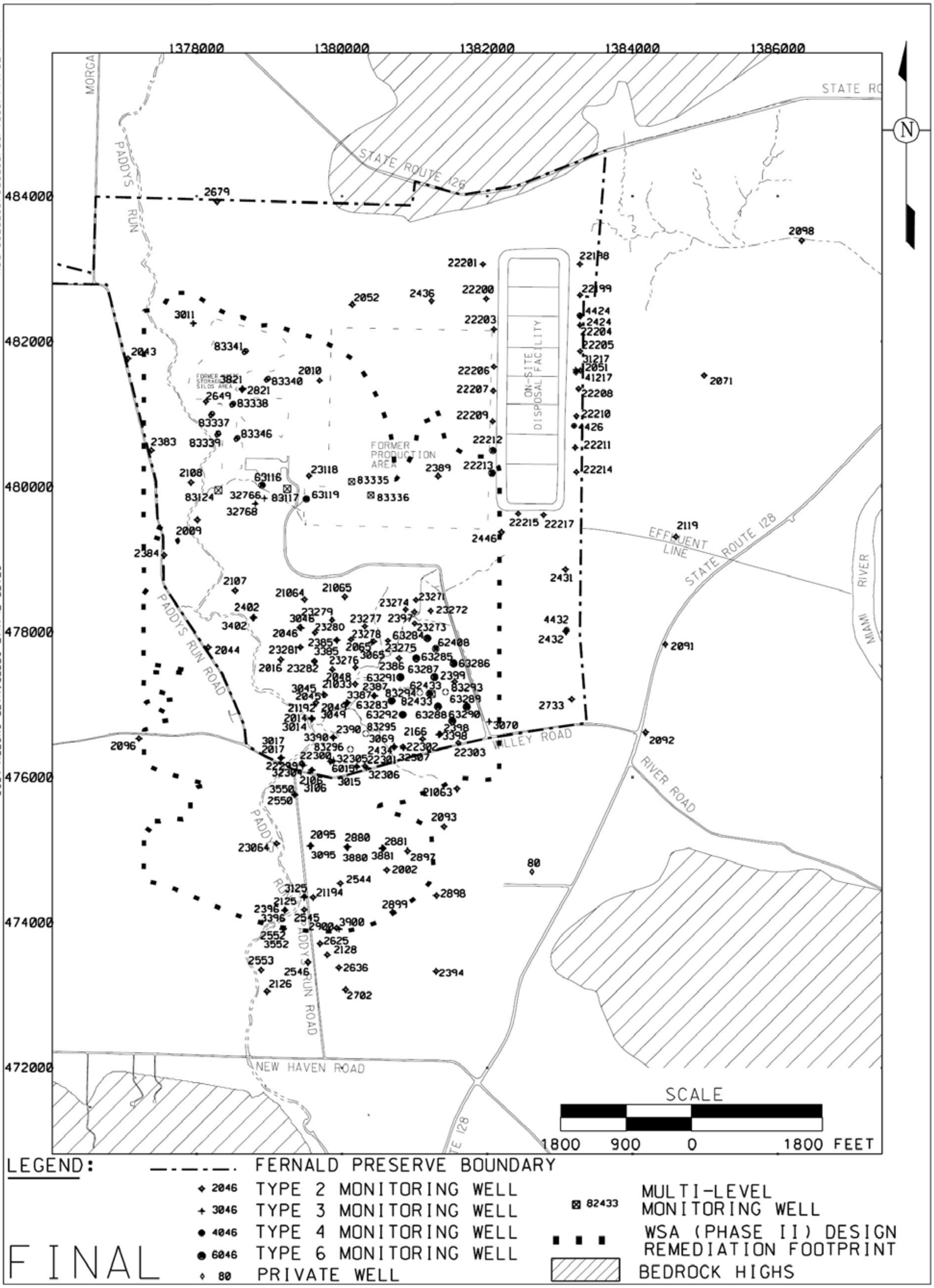

Figure 3–8. Groundwater Elevation Monitoring Wells

Table 3–7. Analytical Requirements for the Groundwater Monitoring Program

Constituent	Method	Sample Type	ASL[a]	Holding Time[b]	Preservative[b]	Container[b,c]
General Chemistry:						
Fluoride	300.0[d], 340.2[d], or 4500C[e]	Grab	B	28 days	None	Plastic
Nitrate/Nitrite	353.1[d], 353.2[d], 4500D[e], or 4500E[e]	Grab	B	28 days	Cool to 4EC, H_2S0_4 to pH <2	Plastic or glass
Phosphorus	365.(all)[d] or 4500E[e]	Grab	B	28 days	Cool to 4EC, H_2S0_4 to pH <2	Plastic or glass
Inorganics:						
Metals	6020[f], 7000A[f], or 6010B[f]	Grab	B	6 months	HNO_3 to pH <2	Plastic or glass
Radionuclides: (All Radiological)	DOE-EML HASL 300[g]	Grab	B	6 months or 5 × half-life, whichever is less	HNO_3 to pH <2	Plastic or glass
Volatile Organics:	8260B[f]	Grab	B	7 days	Cool to 4EC	Glass vial with Teflon-lined septum cap
		Grab	B	14 days	Cool to 4EC H_2SO_4, HCl, or solid $NaHSO_4$ to pH <2	Glass vial with Teflon-lined septum cap
Field Parameters[h]:	LM SAP & LM QAPP[i]	Grab	A	NA[j]	NA[j]	NA[j]

Note: The analytical site-specific contract identifies the specific method.

[a]The ASL may become more conservative if it is necessary to meet detection limits or data quality objectives.
[b]Appropriate preservative, holding time, and container will be used for the corresponding method.
[c]Container size is left to the discretion of the individual laboratory.
[d]Methods for Chemical Analysis of Water and Wastes (EPA 1983).
[e]Standard Methods for the Examination of Water and Wastewater (APHA 1989).
[f]Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (EPA 1998).
[g]Procedures Manual of the Environmental Measurements Laboratory (DOE 1997b).
[h]Field parameters include dissolved oxygen, pH, specific conductance, temperature, and turbidity.
[i]The LM SAP and LM QAPP provide field analytical methods.
[j]NA = not applicable.

List of Groundwater Elevation Monitoring Wells

80	2389	3017	22203	32306
2002	2390	3045	22204	32307
2009	2394	3046	22205	32766
2010	2396	3049	22206	32768
2014	2397	3065	22207	41217
2016	2398	3069	22208	62408
2017	2399	3070	22209	62433
2043	2402	3095	22210	63116
2044	2424	3106	22211	63119
2045	2431	3125	22212	63283
2046	2432	3385	22213	63284
2048	2434	3387	22214	63285
2049	2436	3390	22215	63286
2051	2446	3396	22217	63287
2052	2544	3398	22299	63288
2065	2545	3402	22300	63289
2071	2546	3550	22301	63290
2091	2550	3552	22302	63291
2092	2552	3821	22303	63292
2093	2553	3880	23064	82433
2095	2625	3881	23118	83117
2096	2636	3900	23271	83124
2098	2649	4424	23272	83293
2106	2679	4426	23273	83294
2107	2702	4432	23274	83295
2108	2733	6015	23275	83296
2119	2821	21033	23276	83335
2125	2880	21063	23277	83336
2126	2881	21064	23278	83337
2128	2897	21065	23279	83338
2166	2898	21192	23280	83339
2383	2899	21194	23281	83340
2384	2900	22198	23282	83341
2385	3011	22199	31217	83346
2386	3014	22200	32304	
2387	3015	22201	32305	

Not filtering groundwater samples collected at monitoring wells is a more conservative (and an EPA–recommended) approach to determining the true mobility of metals and uranium in groundwater. Filtering of groundwater samples at monitoring wells may take place on a case-by-case basis if deemed appropriate.

If filtering is conducted, the reasons for filtering will be presented to the EPA and OEPA as soon as possible through the routine weekly report and annually through the site environmental report.

Due to the temporary nature of direct-push sampling locations and the smaller amount of development that takes place compared to a monitoring well, direct-push samples are often turbid. Therefore, direct-push groundwater samples are routinely filtered through a 5-micron filter. Measured uranium concentrations in direct-push samples collected in 2001 were consistently similar regardless of whether or not the sample was filtered using a 5-micron filter or a 0.45-micron filter. Therefore, direct-push samples for uranium analysis are routinely filtered through a 5-micron filter only. Exceptions to this filtering procedure include the collection of Waste Storage Area parameters as discussed in Section 3.6.2.3.

3.6.2.8 Quality Control Sampling Requirements

Field quality control samples will be collected to assess the accuracy and precision of field and laboratory methods as outlined in LM SAP and LM QAPP. These samples will be collected and analyzed in order to evaluate the possibility that some controllable practice, such as decontamination, sampling technique, or analytical method, may be responsible for introducing bias in the analytical results. The following types of quality control samples will be collected: sampling equipment rinsates, trip blanks, and duplicate samples. Each quality control sample is preserved using the same method for groundwater samples.

The quality control sample frequencies will be tracked to ensure that proper frequency requirements are met as follows:

- Trip blanks will be prepared for each sampling team on each day of sampling when organic compounds are included in the respective analytical program.
- They will be prepared before entering the field, and will be taken into the field and handled along with the collected samples. Trip blanks will not be opened in the field.
- Equipment rinsates will be collected for every 20 groundwater samples that are collected using reusable sampling equipment. If a specific sampling activity consists of less than 20 groundwater samples, then a rinsate sample will still be required. Rinsates are not required when dedicated well equipment or disposable sampling equipment is used.
- Field duplicates will be collected for every 20 groundwater samples (or a fraction thereof) if the specific sampling program consists of fewer than 20 samples.

The groundwater samples associated with each quality control sample also will be tracked to ensure traceability in the event that contaminants are detected in the quality control samples.

3.6.2.9 Decontamination

In general, decontamination of equipment is minimized due to limited use of reusable equipment during sample collection. However, if decontamination is required, then equipment will be cleaned between sample locations. The decontamination is identified in the LM QAPP and more specifically outlined in the LM SAP.

3.6.2.10 Waste Disposition

Wastes that will be generated during sampling activities are purge water, decontamination solutions, and contact wastes. The following subsections provide the proposed disposition methodology for each type of waste generated.

<u>Purge Water and Decontamination Solutions:</u> All decontamination wastewater and purge water will be containerized and disposed through the CAWWT for treatment. The point of entry into the CAWWT will either be via the CAWWT back wash basin or the OSDF permanent lift station.

<u>Contact Wastes:</u> Contact wastes, such as personal protective equipment, paper towels, and other solid wastes, will be placed in plastic bags and put in dumpsters.

3.6.2.11 Monitoring Well Maintenance

Monitoring wells at the Fernald Preserve will be maintained in order to keep them in a condition that is protective of the subsurface environment and to ensure that representative groundwater samples can be obtained. Two types of activities are recognized: well maintenance inspections and well evaluations.

<u>Well Maintenance Inspections</u>

Routine inspections of Great Miami Aquifer groundwater monitoring wells will be conducted during sampling or collection of water levels (at a minimum of once a year if the well is not being routinely sampled) to determine if the well is protective of the environment based on the inspection criteria below. Wells may be inspected more frequently if they are located in an area of active surface restoration. All assessment and maintenance activities will be recorded on applicable field data forms. The inspections include, but are not limited to, the following:

- Ensuring that the well identification number is painted or welded on the top of the lid.
- Inspecting the ground surrounding the well for depressions and channels that allow surface water to collect and flow toward the wellhead; and for debris and foreign material that could leach contaminants into the subsurface or otherwise interfere with well sampling.
- Ensuring visibility and accessibility to the well.
- Inspecting locking lids and padlocks to check for rust and ease of operation.
- Inspecting the exposed (protective) well casing to ensure that it is free of cracks and signs of corrosion; it is reasonably plumb with the ground surface; it is painted bright orange; the drain hole is clear; it is free of debris; and the well casing has no sharp edges.
- Removing and inspecting the well cap to ensure that it is free of debris, fits securely, and the vent hole is clear; and if equipped with a ground-flush cap, ensuring that it is water-tight to prevent surface water from entering the well.
- Inspecting concrete surface seals for settling and cracking.
- If exterior guards are used to protect the well, then periodically inspecting the guards for visibility and damage and repaint, if necessary.

Well Evaluation

A monitoring well evaluation will be initiated if there is an indication that the monitoring well may no longer by yielding a representative groundwater sample. A monitoring well may no longer be yielding a representative groundwater sample for several reasons. The well's integrity may be compromised, as determined through the well maintenance inspections discussed above. The downhole integrity of the monitoring well may be compromised as evidenced through an increase in the turbidity of the collected sample or the amount of sediment measured in the bottom of the monitoring well. The bioaccumulation of metals around the monitoring well may be occurring as evidenced by the cloudiness or coloration of the collected water sample or the odor of the collected sample. If a problem is suspected then the following work may be performed to evaluate the cause:

- Review existing well installation documentation.
- Review well history and historical water quality data to identify whether it produces consistently clear or turbid samples.
- Review groundwater sampling field records.
- Conduct a downhole camera survey to inspect the integrity of the screen and casing.

At least once a year, an assessment will be made of wells that are sampled as to whether or not the well is yielding a representative sample. This assessment includes, but is not limited to, the following:

- Determining how much sediment has entered the well screen and accumulated in the well; and review historical depth records. This will be done by measuring the depths of those wells that do not have dedicated packers.
- Determining if any foreign material is present in the well (e.g., bentonite grout).
- Determining if the groundwater color has changed over time (e.g., due to iron bacteria).
- Evaluating turbidity within the sample.
- Noting if an odor that could be associated with biofouling (i.e., rotten-egg or fish odor) is present.

Well Maintenance Corrective Actions

Corrective actions to address problems identified in the well maintenance inspections will be conducted as soon as feasible. Corrective maintenance to address excessive turbidity will include the removal of sediment from the well through the redevelopment of the well.

It is possible that minerals can precipitate on well screens or that metals can bioaccumulate around well screens. If it is determined that minerals have precipitated in the well or on the well screen, or that metals have bioaccumulated around the well screen and the representativeness of the groundwater sample is being impacted, then the limited use of chemicals (e.g., chlorine, hydrochloric acid) to remove the mineral build-up or alleviate the biofouling may be considered. It should be noted that CMT wells could probably not be rehabilitated due to the small diameters of the sampling channels. It is understood that chemicals have a very limited application in the rehabilitation of monitoring wells because the chemicals can cause changes such that the well will no longer yield a representative sample (EPA 1991). Changes resulting from the use of chemicals could last for a short time or could be permanent. Therefore, if chemical rehabilitation is attempted, it will only be attempted as a last resort. Water quality parameters (such as Eh [redox potential], pH, temperature, and conductivity) will be measured prior to the application of the chemicals and following the use of the chemicals. These measurements will serve as values for comparison of water quality before and after well maintenance.

If a groundwater monitoring well has been damaged in such a way that it is no longer protective of the subsurface environment and it cannot be repaired, then the well will be plugged and abandoned. If it is determined that the well is not yielding a representative groundwater sample and rehabilitation efforts are not effective in correcting the condition, then the well will be considered for plugging and abandonment. If the well is still protective of the subsurface environment, then it might be used for the collection of water level data even though it does not yield representative groundwater samples. Wells designated for plugging and abandonment may be sampled one last time for a subset of water quality parameters listed in Table 3–5.

The exact parameter list selected for the sampling will be based on the location of the well. CMT wells being plugged and abandoned may have each available channel sampled for total uranium (or any groundwater FRL constituent) prior to being plugged and abandoned, as deemed appropriate. A replacement monitoring well will only be installed if the monitoring well that was plugged and abandoned was being actively monitored for either water quality or water levels. Any preliminary decision not to replace a monitoring well will be discussed with the EPA and OEPA prior to finalizing the decision.

3.6.3 Change Control

Changes to the medium-specific plan will be at the discretion of the project team leader. Prior to implementation of field changes, the project team leader or designee shall be informed of the proposed changes and circumstances substantiating the changes. Any changes to the medium-specific plan must have written approval by the project team leader or designee, quality assurance representative, and the field manager prior to implementation. If a Variance/Field Change Notice is required, it will be completed in accordance with LM QAPP. The Variance/Field Change Notice form shall be issued as controlled distribution to team members and will be included in the field data package to become part of the project record. During revisions to the IEMP, Variance/Field Change Notices will be incorporated to update the medium-specific plan.

3.6.4 Health and Safety Considerations

The Fernald Preserve's health and safety personnel are responsible for the development and implementation of health and safety requirements for this medium-specific plan. Hazards (such as physical, radiological, chemical, and biological) typically encountered by personnel when performing the specified fieldwork will be addressed during team briefings. Health and Safety requirements are addressed in the Fernald Preserve Project Safety Plan.

All involved personnel will receive adequate training to the health and safety requirements prior to implementation of the fieldwork required by this medium-specific plan. Safety meetings will be conducted prior to beginning fieldwork to address specific health and safety issues.

3.6.5 Data Management

Field documentation and analytical results will meet the IEMP data reporting and quality objectives, comply with the LM QAPP, *LM Standard Practice for Validation of Laboratory Data* (DOE 2006i), and the LM SAP. Data documentation and validation requirements for data collected for the IEMP fall into two categories depending upon whether the data are field- or laboratory-generated. Field data validation will consist of verifying medium-specific plan compliance and appropriate documentation of field activities. Laboratory data validation will consist of verifying that data generated are in compliance with ASLs specified in the medium-specific plan. Specific requirements for field data documentation and validation, and laboratory data documentation and validation will be in accordance with the LM QAPP, the *Standard Practice for Validation of Laboratory Data*, and the LM SAP.

There are five analytical levels (ASL A through ASL E) defined for use at the Fernald Preserve. For groundwater, field data documentation will be at ASL A, and laboratory data documentation, in general, will be at ASL B. A more conservative ASL may be required for laboratory data in order to meet required detection limits or in order to ensure data quality objectives. ASL B is appropriate for laboratory-generated data because the data are being used for surveillance during site restoration. ASL B provides qualitative, semi-qualitative, and quantitative data with some quality assurance/quality control checks.

At a minimum, 10 percent of the IEMP field and analytical data will undergo validation to ensure that analytical data are in compliance with the ASL method criteria being requested and in order to meet data quality objectives. The percentage of data validated could increase in order to meet data quality objectives.

Data will be entered into a controlled database using a double-key or other verification method to ensure accuracy. The hard-copy data will be managed in the project file according to LM record keeping requirements and DOE Orders.

3.6.6 Quality Assurance

Assessments of work processes shall be conducted to verify quality of performance and may include audits, surveillances, inspections, tests, data verification, field validation, and peer reviews. Assessments shall include performance-based evaluation of compliance to technical and procedural requirements and corrective action effectiveness necessary to prevent defects in data quality. Assessments may be conducted at any point in the life of the project. Assessment documentation shall verify that work was conducted in accordance with IEMP, LM SAP, and LM QAPP requirements.

Recommended semiannual quality assurance assessments or surveillances shall be performed on tasks specified in the medium-specific plan. These assessments may be in the form of independent assessments or self-assessments, with at least one independent assessment conducted annually. Independent assessments are the responsibility of quality assurance personnel. The project team leader and quality assurance personnel will coordinate assessment activities and comply with the LM QAPP. The project or quality assurance personnel shall have "stop work" authority if significant adverse effects to quality conditions are identified or work conditions are unsafe.

3.7 IEMP Groundwater Monitoring Data Evaluation and Reporting

This section provides the methods to be used in analyzing the data generated by the IEMP groundwater sampling program. It summarizes the data evaluation process and actions associated with various monitoring results. The planned reporting structure for IEMP-generated groundwater data, including specific information to be reported in the annual site environmental report, is also provided.

3.7.1 Data Evaluation

Data resulting from the IEMP groundwater program will be evaluated to meet the program expectations identified in Section 3.4.1. Data evaluation will look at both the operational efficiency and the operational effectiveness of the groundwater remediation system (EPA 1992). Operational efficiency refers to implementing the most efficient remedy possible. The objectives are to minimize downtimes, conduct stable operations, meet planned performance goals, and operate a cost-effective system. Operational efficiency will be assessed by tracking the following:

- Pumping rates for individual wells and modules.
- Gallons of water pumped.
- Extraction well total hours of operation during the year.
- The volume of treated water.
- Planned versus actual gallons of water pumped.

Operational effectiveness refers to the evaluation of the degree of contamination cleanup achieved. Operational effectiveness will be assessed by tracking the following:

- Planned versus actual pounds of uranium removed from the Great Miami Aquifer.
- Pounds of uranium removed per million gallons of water pumped (uranium removal index).
- Running cumulative pounds of uranium removed from the Great Miami Aquifer versus predicted running cumulative pounds of uranium removed from the Great Miami Aquifer.
- Total uranium concentration data collected from extraction wells.
- Total uranium concentration data collected from monitoring wells.
- Water level data collected from monitoring wells.
- Interpretations of capture zones.
- Regression curves of uranium concentration data at extraction wells.
- Regression curves of uranium concentration data at groundwater monitoring wells every 5 years. Regression curves of uranium concentration data at groundwater monitoring wells will be prepared every 5 years because only two data points a year will be added to the database used to generate the curves.

Most of the data will be tabulated, presented in graphs, or presented in maps and evaluated in the following manner:

- Concentration versus time plots for specific constituents.
- Tables identifying wells with constituents above FRL concentrations.
- Mann-Kendall trend analyses for specific constituents.
- Concentration contour maps.

Large quantities of data will be collected and evaluated each year. In order to evaluate the results of the sampling, the data collected for the IEMP will be presented and evaluated using the formats above. The findings of data evaluations will be shared with project personnel. EPA and OEPA have identified that this is a successful method of evaluating and presenting the data. Groundwater monitoring program data will be evaluated to:

- Assess progress in capturing and restoring the area containing the >30-µg/L total uranium plume.
- Assess progress in capturing and restoring the areas affected by non-uranium FRL exceedances.
- Assess water quality at the downgradient Fernald Preserve property boundary.
- Assess model predictions.
- Assess the impact that the aquifer restoration is having on the PRRS plume.
- Meet other monitoring commitments.
- Address community concerns.

The aquifer restoration system is designed to reduce the concentration of uranium and non-uranium FRL constituents in the aquifer to concentrations that are at or below their FRL. Because uranium is the principal COC, the aquifer restoration system has been designed to capture the 30-µg/L total uranium plume, with the understanding that the system may need to be modified in the future to capture and remediate non-uranium FRL constituents.

Extraction wells have been positioned within each restoration module to capture the uranium plume. Operational decisions and pumping changes will focus on the capture of the uranium plume. Operational changes to meet non-uranium FRL concentrations are considered to be a secondary objective. However, evaluation of the need for an operational change to address non-uranium FRL constituents will be ongoing throughout aquifer remediation and is expected to gain in importance as the achievement of the uranium objective approaches.

Following is a discussion of how each of the groundwater program expectations are intended to be met through evaluation of IEMP groundwater data.

<u>Capturing and Restoring the Area Containing the >30-µg/L Total Uranium Plume</u>
Capture and restoration of the area containing the >30-µg/L total uranium plume will be evaluated using groundwater elevation data and the most current maximum total uranium plume interpretation. Groundwater elevation maps with capture zone and flow divide interpretations will be prepared to evaluate the extent of capture.

Remediation of the 30-µg/L total uranium plume will be assessed by monitoring total uranium concentrations over time. The 30-µg/L maximum total uranium plume will be mapped and compared to previous maps to determine how the plume has changed in response to remediation. Direct-push sampling data will be used throughout the remedy to supplement fixed monitoring well location data by providing vertical profile concentration data.

If a new total uranium FRL exceedance is detected in the aquifer, then an attempt will be made to determine the cause of the exceedance. Considerations will include:

- Movement of known total uranium contamination in response to pumping, or natural migration.
- Previously undetected uranium contamination that has now moved into a monitoring zone as a result of pumping, or natural migration.

When a new extraction well begins operating, water levels will be collected more frequently until conditions have stabilized. Once conditions have stabilized, monitoring will fall back to the regular IEMP monitoring schedule. Individual startup plans will provide specifics on the frequency of water level and water quality data collection during the startup time period.

<u>Capturing and Restoring the Areas Affected by Non-uranium FRL Exceedances</u>
The OU5 ROD identifies 49 FRL constituents, other than total uranium, that also need to be tracked as part of the aquifer restoration. These 49 constituents are collectively referred to as the non-uranium FRL constituents. During the aquifer restoration, groundwater monitoring will take place for the non-uranium FRL constituents. Constituents that have been detected in the aquifer above their respective FRL will be monitored semiannually.

Non-uranium FRL concentration trends in the Great Miami Aquifer will be assessed through trend analysis when sufficient data have been obtained. The Mann-Kendall statistical test for trend will be used to facilitate the trending interpretation. Concentrations versus time plots may be used to illustrate how the concentrations are trending.

If a new non-uranium FRL exceedance is detected in the aquifer, then an attempt will be made to determine the cause of the exceedance. Considerations will include:

- Movement of known contamination in response to pumping or natural migration.
- Previously undetected contamination that has now moved into a monitoring zone as a result of pumping or natural migration.

Any FRL exceedance detected at a property boundary/plume boundary well location will be evaluated using the same data evaluation protocol that was approved for the *Restoration Area Verification Sampling Program, Project-Specific Plan* (DOE 1997c) in order to determine if additional action is required. The constituent concentration data over time will be graphed. If two or more sampling events following an FRL exceedance indicate that the concentrations are below the FRL, then the location will not be considered for remediation or further monitoring above and beyond what is already prescribed by the IEMP. If sampling following the initial FRL exceedance indicates that the exceedance was not just a one-time occurrence, and the exceedance is judged to be the result of Fernald Preserve activities (either historical or current), then action will be taken to address the exceedance.

Meeting Other Monitoring Commitments

Other groundwater monitoring commitments that need to be addressed are private well sampling, property boundary monitoring, and fulfillment of DOE Order 450.1 requirements to maintain an environmental monitoring program for groundwater.

Total uranium data collected at private wells will be graphed to illustrate changes and will be used in the preparation of total uranium contour maps. Data collected from the Fernald Preserve property/plume boundary monitoring system will be compared to FRLs. This will facilitate the detection and monitoring of FRL exceedances and will determine if interim actions are warranted, in addition to implementing the site-wide aquifer restoration. Lastly, this groundwater monitoring program presented in the IEMP, along with the groundwater data reporting in IEMP annual integrated site environmental reports, fulfills DOE Order 231.1 requirements.

Groundwater Modeling

Groundwater uranium concentration data and water level data obtained through the life of the remedy will be compared against model-predicted concentrations and water levels to evaluate how reasonable the predictions are over the long term. Individual well residuals (model-predicted concentration versus actual measured concentrations) will be determined without running the model. A mean residual calculation for each monitoring event will also be determined. Monitoring wells in the remediation footprint of the aquifer will be included in the residual exercise. Results of the first assessment were provided in the 2005 site environmental report. A brief summary of background information on the groundwater model follows.

Since modeling was conducted for the RI/FS and *Baseline Remedial Strategy* reports, the model has undergone several changes in order to improve its capability for making water level and uranium concentration predictions. DOE has changed from the Sandia Waste Isolation Flow and Transport (SWIFT) groundwater modeling code to the Variably Saturated Analysis Model in 3 Dimensions (VAM3D) modeling code for all site groundwater modeling operations. This transition has been documented in detail in *Development and Verification of VAM3DF, a Numerical Flow and Transport Modeling Code* (HydroGeologic 1998).

The groundwater modeling grid used in the SWIFT model was retained for the VAM3D model. However, vertical discretization of the model was increased in the VAM3D model to 12 vertical layers instead of the six layers used in the SWIFT model.

The groundwater model was recalibrated for flow to address observed changes in water level conditions and to address seasonal changes in water levels prior to it being used to support the design of the Waste Storage Area Module in 2001, the South Field (Phase II) Module in 2002, and the Waste Storage Area (Phase II) Module in 2005. The 12-layer VAM3D model was recalibrated to current groundwater elevations in May 2000 with calibration activities detailed in the *Great Miami Aquifer VAM3D Flow Model Recalibration Report* (DOE 2000b). With increased vertical resolution in the VAM3D ZOOM model (14 layers compared to 12 layers in the original VAM3D model), predicted wellhead concentrations for total uranium more closely match observed wellhead concentrations. Wellhead concentration decline curves were first published in the 2004 Site Environmental Report (DOE 2005f) comparing modeled versus observed wellhead concentrations for total uranium. These comparisons continue to be provided in annual site environmental reports.

In the past, initial conditions in the fate and transport portion of the groundwater model have been routinely updated. Until recently, the update of initial conditions was considered necessary to incorporate additional characterization data collected during the design of the planned groundwater restoration modules (South Plume Module, South Field [Phases I and II] Module, and Waste Storage Area [Phases I and II] Module). Without the update of initial conditions, the module designs would not have reflected the most up-to-date plume conditions. Because the last planned aquifer restoration module design was recently completed (Waste Storage Area [Phase II] Design), the process of routinely updating initial conditions in the fate and transport portion of the groundwater model has stopped.

Because of significant seasonal changes in Great Miami Aquifer groundwater elevations, three sets of steady-state flow model boundary conditions were developed for the VAM3D model as a result of the recalibration effort. These three steady-state flow model boundary conditions correspond to nominal groundwater elevations, and minimum and maximum groundwater elevations observed during the wet and dry seasons of the year, respectively. The wet and dry boundary condition data sets will be used in future groundwater modeling activities to predict aquifer remedy performance under those conditions.

To facilitate computational efficiency, a local VAM3D ZOOM model was designed covering a smaller area than the 12-layer VAM3D model. The VAM3D ZOOM model contains 14 layers and covers an area just large enough to encompass the total uranium plume and the extraction wells in the aquifer remedy. The VAM3D ZOOM model design is documented in *Integration of Data Fusion Modeling (DFM) with VAM3DF Contaminant Transport Code* (HydroGeologic 2000).

Because the ZOOM model boundaries are near some of the aquifer remedy extraction wells, ZOOM model steady-state flow boundaries must be derived from the larger 12-layer VAM3D model to avoid model boundary effects impacting flow model predictions of remedy performance. For all current and future operational flow modeling activities, aquifer remedy pumping scenarios are first run to steady-state in the large 12-layer VAM3D model then ZOOM model boundary values are derived from the output of the 12-layer flow model run. This technique is described in more detail in Design for Remediation of the Great Miami Aquifer, South Field (Phase II) Module.

It is understood that the groundwater model may need to be recalibrated for flow if measured water levels and model predictions are not adequate for managing the remedy. If future flow model calibration efforts are performed, the large 12-layer VAM3D model will be recalibrated to observed groundwater elevation data; then VAM3D ZOOM model boundary conditions will be derived from the larger 12-layer VAM3D model. Calibration standards will be the same as those used to calibrate the SWIFT model.

The basic strategy for assessing flow predictions will be as follows:

- Model-predicted water level values will be compared to actual field measured values. The decision to recalibrate the groundwater model will be based on how close the model predictions are to field measured values.
- The difference between the maximum and minimum measured groundwater elevation over time will be used to define a water level elevation range for a particular well. The water level range is the result of seasonal variations and long-term water level trends within the aquifer. A range of water levels over time has been established for each water level monitoring well identified in the IEMP.
- If the difference between measured elevations and modeled predictions is greater than 5 feet for more than one-third of the monitoring wells within the capture zone of the

extraction system, or for a significant local area of the model domain, then the need to implement model recalibration for the affected area of the model will be evaluated. All relevant groundwater data acquired since the previous flow model calibration will be considered in future flow model calibrations. Comparisons will recognize that modeled predictions represent average conditions within a model block and monitoring wells are not usually located at the center of a model block. One solution might be to compare the surrounding eight model blocks to the actual measured elevation.

Assess the Impact that the Aquifer Restoration Has on the Paddys Run Road Site Plume
As was done since 1997, concentration data collected for key PRRS constituents will be evaluated using trend analysis. Water level maps will be produced to determine where capture is occurring due to pumping in the South Plume Module.

Adequately Address Community Concerns
The IEMP fulfills the informational needs of the Fernald community by preparing groundwater environmental results in the annual site environmental report. DOE makes these reports available to the public. Comments received over the life of the IEMP program regarding the IEMP groundwater program will be considered for future revisions to the IEMP.

Groundwater Certification Process and Stages
A Groundwater Certification Plan has been prepared for the Groundwater Remedy. The objective of the Certification Plan is to document the process that will be followed to certify the aquifer remedy objectives have been met. As explained below, pump-and-treat operations are currently in progress at the Fernald Preserve. The IEMP is the controlling document for remedy performance monitoring during the pump-and-treat operational period. The IEMP will continue to be the controlling document for all groundwater monitoring needed to support the certification process following completion of pump-and-treat operations.

Figure 3–9 illustrates the groundwater certification process. Six stages have been identified for the certification process:

- Stage I: Pump-and-Treat Operations
- Stage II: Post Pump-and-Treat Operations/Hydraulic Equilibrium State
- Stage III: Certification/Attainment Monitoring
- Stage IV: Declaration and Transition Monitoring
- Stage V: Demobilization
- Stage VI: Long-Term Monitoring

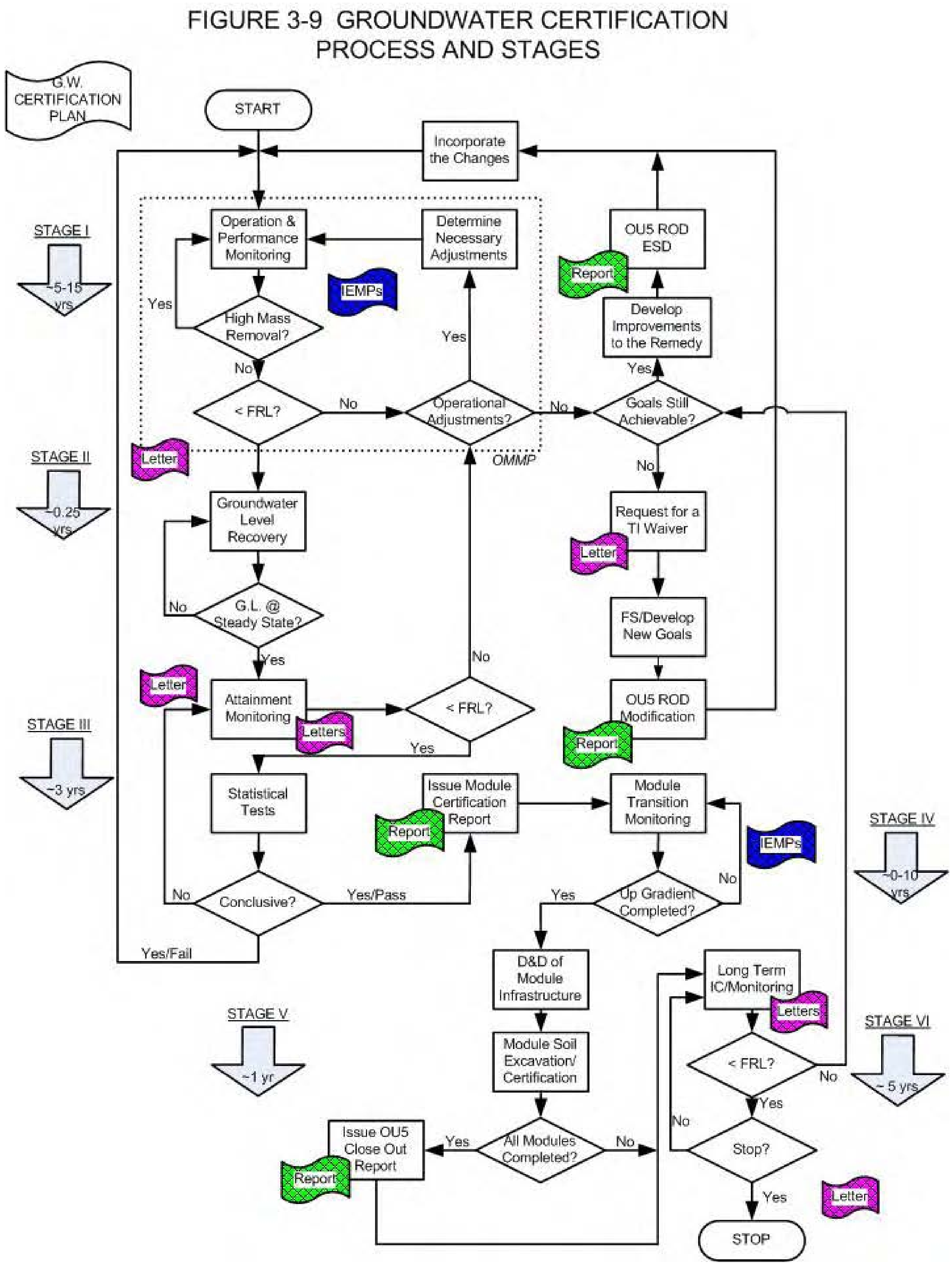

Figure 3–9. Groundwater Certification Process and Stages

Remedy performance monitoring is currently supporting pump-and-treat operations. As illustrated in Figure 3–9, remedy performance monitoring is conducted to assess the efficiency of mass removal and to gauge performance in meeting FRL objectives. If it is determined that high mass removal is not being maintained, or FRL goals are not being achieved, then the need for operational adjustment will be evaluated and implemented if deemed appropriate. A change to the operation of the aquifer restoration system would be implemented through the OMMP. A groundwater monitoring change, if found to be necessary, would be implemented through the IEMP. If additional characterization data are needed beyond the current scope of the IEMP, then a separate sampling plan will be prepared. Additional sampling activities may use other sampling techniques, such as a direct-push sampling tool, which has been successfully used at the Fernald Preserve to obtain groundwater samples without the use of a permanent monitoring well.

The IEMP will be used to document the approach for determining when various modules can be removed from service and groundwater monitoring can focus on subsequent stages of the groundwater certification process.

3.7.2 Reporting

The IEMP groundwater program data will be reported on the DOE-LM website and in the annual site environmental report. Groundwater data that support the On-Site Disposal Facility Groundwater/Leak Detection and Leachate Monitoring Plan will be provided in the same manner. Additional information on IEMP data reporting is provided in Section 7.0.

Data pertaining to the groundwater program will be provided on the DOE-LM website. The data will be in the format of searchable data sets and/or downloadable data files. This site will be updated every 2 to 4 weeks, as data become available.

The annual site environmental report will be issued each June for the previous calendar year. This comprehensive report discusses a year of IEMP data previously reported on the DOE-LM website. The report includes the following:

<u>Operational Assessment</u>

- The set point pumping rates for each extraction well during the year.
- The uranium removal rate of individual wells.
- Extraction well total hours of operation during the year.
- The volume of treated groundwater.
- Extraction well operating time expressed as a percentage of total available operating time.
- The volume of water pumped from each extraction well during the year.
- Planned versus actual gallons of water pumped.
- The net water balance.
- Total pounds of uranium removed during the year.
- Total pounds of uranium removed from the aquifer since the start of remediation.
- Planned versus actual pounds of uranium removed from the Great Miami Aquifer.
- Running cumulative pounds of uranium removed from the Great Miami aquifer versus predicted running cumulative pounds of uranium removed from the Great Miami Aquifer.

- Total uranium concentration data collected from extraction wells.
- Total uranium concentration data collected from monitoring wells.
- Water level data collected from monitoring wells.
- The maximum, minimum, and average uranium concentration sent to treatment during the last year.
- The monthly average uranium concentration in water discharged to the Great Miami River during the year.
- Pumping rate figures for each extraction well.
- Regression curves of uranium concentration data at extraction wells.
- Regression curves of uranium concentration data at groundwater monitoring wells (every 5 years).

Aquifer Conditions

- The area of capture during the year.
- A description of the geometry of the total uranium plume during the year.
- The effect that restoration had (i.e., pumping) on the PRRS plume during the year.
- The status of non-uranium FRL exceedances, including any newly detected FRL exceedances.
- Identification of any new areas of FRL exceedances.
- A comparison of groundwater restoration performance with respect to model predictions established in the *Baseline Remedial Strategy Report*.
- Any changes that may have been made to the operation or design.

Data that Support the OSDF Groundwater/Leak Detection and Leachate Monitoring Plan

- Status information pertaining to the OSDF wells along with baseline data summaries.
- Leachate volumes and concentrations from the leachate collection system and from the leak detection system for the OSDF.
- Results of quarterly groundwater sampling initiated after waste is placed in a cell of the OSDF.

In addition, the annual site environmental report will include trend analysis of the data collected from the OSDF.

Because the IEMP is a living document, annual reviews and 5-year revisions have been instituted. The annual review cycle provides the mechanism for identifying and initiating any groundwater program modifications (e.g., changes in constituents, locations, or frequencies) that are necessary to align the IEMP with the current activities. Any program modifications that may be warranted prior to the annual review would be communicated to EPA and OEPA.

4.0 Surface Water and Treated Effluent Monitoring Program

Section 4.0 provides a description of the routine site-wide surface water and treated effluent monitoring to be performed at the Fernald Preserve. This includes compliance-based monitoring and reporting obligations for surface water and treated effluent, and a medium-specific plan for conducting all surface water and treated effluent monitoring activities.

4.1 Integration Objectives for Surface Water and Treated Effluent

Because surface water represents both a contaminant transport pathway and a route of exposure for human and ecological receptors, routine monitoring of surface water is necessary to confirm that the Fernald Preserve's point and non-point discharges to receiving waters fall below established thresholds. The monitoring activities for surface water will thus function as both a surveillance and compliance tool at the Fernald Preserve. These measures will help document the protection of both groundwater (via the surface water cross-medium pathway) and intended surface water uses in the vicinity of the Fernald Preserve.

The IEMP is the designated mechanism for conducting the site-wide surface water surveillance and compliance monitoring downstream from site controls. In this role, the IEMP serves to integrate several compliance based monitoring and reporting programs currently in existence for the Fernald Preserve:

- The discharge monitoring and reporting program related to the site's NPDES Permit.
- The radiological monitoring of and reporting for the treated effluent mandated by the OU5 ROD.
- The IEMP Characterization Program which combines portions of the former Environmental Monitoring Program (EMP) that has been ongoing at the Fernald Preserve since the 1950s and was updated in the IEMP, Revision 0 (DOE 1997d), to accommodate surface water monitoring needs during remediation and during post-closure. As indicated in the OMMP, this monitoring is performed as a supplement in order to monitor surface water and treated effluent for potential site impacts to various receptors during aquifer remediation.

As discussed in Section 4.5, these programs have been brought together under a single reporting structure to facilitate review of the performance of the Fernald Preserve's surface water protection actions and measures.

4.2 Analysis of Regulatory Drivers, DOE Policies, and Other Fernald Preserve Site-Specific Agreements

This section presents a summary evaluation of the regulatory drivers governing the monitoring of the Fernald Preserve's point source discharges to Paddys Run and the Great Miami River. The intent of this section is to identify the pertinent regulatory requirements, including ARARs and to-be-considered requirements, for the scope and design of the surface water monitoring program. These requirements will be used to confirm that the program satisfies the regulatory obligations for monitoring that have been activated by the RODs and will achieve the intentions of other pertinent criteria, such as DOE Orders and the Fernald Preserve's existing agreements and permits, as appropriate, that have a bearing on the scope of surface water and treated effluent monitoring.

4.2.1 Approach

The analysis of the regulatory drivers and policies for surface water and treated effluent was conducted by examining the suite of ARARs and to-be-considered requirements in the OU5 ROD to identify the subset with specific environmental monitoring requirements. The Fernald Preserve's existing compliance agreements issued outside the CERCLA process were also reviewed.

4.2.2 Results

The following summary of regulatory drivers, compliance agreements, and DOE Orders was found to govern the monitoring scope and reporting requirements for surface water and treated effluent:

- CERCLA ROD for remedial actions at OU5, which requires remediation of the site such that the surface water pathway is protective of the underlying Great Miami Aquifer and various surface water environmental receptors. The surface water FRLs provided in the OU5 ROD considered and incorporated all chemical specific ARARs and to-be-considered requirements for the protection of human health via the surface water pathway. In addition, treatment performance based limits were established restricting total uranium mass discharged to the Great Miami River to 600 lbs/year and a uranium concentration limit of 30 µg/L as a monthly average. (The concentration limit of 30 µg/L established in the OU5 Explanation of Significant Differences Document.)
- Per the CERCLA Remedial Design Work Plan for remedial actions at OU5, monitoring will be conducted following the completion of cleanup as required to assess the continued protectiveness of the remedial actions. The IEMP will specify the type and frequency of environmental monitoring activities to be conducted during remedy implementation, and ultimately, following the cessation of remedial operations as appropriate. The IEMP will delineate the Fernald Preserve's responsibilities for monitoring of surface water and sediment over the life of the remedy, and ensure that FRLs are achieved at project completion.
- The current NPDES Permit for the Fernald Preserve, which triggers a variety of site-specific surface water and treated effluent sampling, analysis, and reporting requirements (as specified in OAC 3745 33) for non radiological contaminants .
- The 1986 FFCA, which requires that the Fernald Preserve maintain a continuous sample collection program for radiological constituents at the Fernald Preserve's treated effluent discharge points and report the results quarterly to the EPA, OEPA, and the Ohio Department of Health. The sampling program to address this requirement has been modified over the years and is currently governed by an agreement reached with EPA and OEPA in early 1996 as described in the letter "Phase VII Removal Actions and Reporting Requirements Under the Fernald Environmental Management Project Legal Agreements" from DOE to EPA (DOE 1996c). This agreement became effective May 1, 1996 and has since been modified, documented and approved through biennial revisions of the IEMP.

- DOE Order 450.1, *Environmental Protection Program Requirements*, which requires DOE facilities that use, generate, release, or manage significant pollutants or hazardous materials to develop and implement an environmental monitoring plan. Each DOE site's environmental monitoring plan must contain the design criteria and rationale for the routine treated effluent monitoring and environmental surveillance activities of the facility.
- DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, which obligates the Fernald Preserve to perform surveillance monitoring of surface water to ensure that radiological dose limits to the public in the DOE Order are not exceeded. Under these requirements, the exposure to members of the public associated with activities at DOE facilities from all pathways must not exceed, in 1 year, an effective dose equivalent greater than 100 millirem (mrem). Studies in support of the OU5 feasibility study demonstrated for all media that combined exposure to radiological COCs at their respective FRLs fall well below the DOE dose requirement. Therefore, monitoring designed to track and document the CERCLA FRL based remediation of the site meets the intent of DOE Order 5400.5.

The surface water and treated effluent monitoring program described in this IEMP has been developed with full consideration of these regulatory drivers. Table 4–1 lists each of these IEMP drivers and the associated monitoring conducted to comply with them. Sections 4.5 and 7.0 provide the Fernald Preserve's current and long-range plan for complying with the reporting requirements invoked by these drivers.

Table 4–1. Fernald Preserve Surface Water and Treated Effluent Monitoring Program Regulatory Drivers and Responsibilities

	DRIVER	ACTION
IEMP	DOE Order 450.1, environmental monitoring plan for all media	The IEMP describes treated effluent and surveillance monitoring as required by DOE Order 450.1.
	DOE Order 5400.5, *Radiation Protection of Public and Environment*	The IEMP includes a description for routine sampling of Paddys Run and on-site drainage ditches for radionuclides.
	OU5 ROD	The IEMP will be modified toward completion of the remedial action to include sampling to certify FRL achievement. IEMP includes monitoring for performance based uranium discharge limits.
	NPDES Permit	The IEMP describes routine sampling of permit-designated effluent discharges and storm water drainage points for NPDES Permit constituents.
	Federal Facilities Compliance Agreement Radiological Monitoring	The IEMP describes the routine sampling at the Parshall Flume (PF 4001) for radiological constituents.

Note that soil and sediment at the Fernald Preserve has been certified, with the exception of those areas identified in Figure 2–2. It is, therefore, not expected that FRL exceedances will occur in association with uncontrolled runoff.

4.3 Program Expectations and Design Considerations

4.3.1 Program Expectations

The IEMP surface water and treated effluent monitoring program is being designed to collect data sufficient to meet the following expectations:

- Provide an ongoing assessment of the potential for cross-medium impacts from surface water to the underlying Great Miami Aquifer at locations near the point where the protective glacial overburden has been breached by site drainages.
- Document whether the sporadic exceedances of FRLs in various site drainages (noted in IEMP reports) continue to occur at key on property locations, at the property boundary on Paddys Run, and in the Great Miami River outside the mixing zone, and determine if monitoring can be reduced based on surface water data results.
- Provide an assessment of impacts to surface water due to uncontrolled runoff (As noted previously, soil and sediment at the Fernald Preserve has been certified with exception of those areas identified in Figure 2–2).
- Provide additional data at background locations on Paddys Run and the Great Miami River to refine the ability to distinguish site impacts from background.
- Continue to fulfill monitoring and reporting requirements associated with the site NPDES Permit.
- Continue to fulfill monitoring and reporting requirements associated with the FFCA and OU5 ROD.
- Continue to fulfill DOE Order 450.1 requirements to maintain an environmental monitoring plan for surface water.
- Continue to address the concerns of the community regarding the magnitude of the Fernald Preserve's discharges to surface water (i.e., to Paddys Run and the Great Miami River).

The following section provides the design considerations required to fulfill each of these expectations.

4.3.2 Design Considerations

4.3.2.1 Constituents of Concern

A comprehensive listing of COCs has been developed and provides the suite of parameters that have been evaluated for monitoring. Table 4–2 presents this information. The following is a description of each of the columns in Table 4–2.

- Column 1, Constituent: This column represents the suite of constituents considered for monitoring in the surface water pathway as a result of the RI/FS process at the Fernald Preserve. It represents the constituents for which a FRL was established in the OU5 ROD.
- Column 2, Final Remediation Levels: This column represents the human/health protective remediation levels for surface water that were established in the OU5 ROD.

Table 4–2. Surface Water Selection Criteria Summary

Constituent[a]	FRL[b]	FRL Basis[b]	95th Percentile Background Level in Surface Water[c,d]			
			Paddys Run		Great Miami River	
			Original	Revised	Original	Revised
General Chemistry (mg/L)						
Fluoride	2.0	A	0.22	0.091	0.9	0.504
Nitrate/Nitrite	2400	R	1.7	4.90	6.6	7.87
Inorganics (mg/L)						
Antimony	0.19	A	ND	0.0012	ND	0.00175
Arsenic	0.049	R	ND	0.00616	0.0036	0.0139
Barium	100	R	0.053	0.0545	0.1	0.100
Beryllium	0.0012	A	ND	0.0003	ND	0.0009
Cadmium	0.0098	B	ND	0.00075	0.01	0.00375
Chromium (VI)[e]	0.010	D	ND	0.00943	ND	0.00991
Copper	0.012	A	ND	0.00652	0.012	0.0141
Cyanide	0.012	A	ND	0.00367	0.005	0.00412
Lead	0.010	B	ND	0.00568	0.010	0.00958
Manganese	1.5	R	0.035	0.229	0.08	0.113
Mercury	0.00020	D	ND	0.000126	ND	0.000175
Molybdenum	1.5	R	ND	0.00328	0.02	0.00902
Nickel	0.17	A	ND	0.00792	0.023	0.0116
Selenium	0.0050	A	ND	0.00254	ND	0.00293
Silver	0.0050	D	ND	0.000706	ND	0.000348
Vanadium	3.1	R	ND	0.0188	ND	0.00671
Zinc	0.11	A	ND	0.0361	0.045	0.0463

Table 4–2. Surface Water Selection Criteria Summary (continued)

Constituent[a]	FRL[b]	FRL Basis[b]	95th Percentile Background Level in Surface Water[c,d]			
			Paddys Run		Great Miami River	
			Original	Revised	Original	Revised
Radionuclides (pCi/L)						
Cesium-137	10	R	3.1	4.74	ND	3.16
Neptunium-237	210	R	-	0.054	ND	0.083
Lead-210	11	R	-	2.97	-	2.45
Plutonium-238	210	R	ND	ND	ND	0.038
Plutonium-239/240	200	R	0.09	0.093	ND	0.01
Radium-226	38	R	0.35	0.844	0.41	0.728
Radium-228	47	R	2.1	1.98	2.2	3.85
Strontium-90	41	R	0.96	1.09	ND	1.14
Technetium-99	150	R	ND	4.65	ND	7.65
Thorium-228	830	R	ND	0.238	0.62	0.234
Thorium-230	3500	R	ND	0.543	0.36	0.789
Thorium-232	270	R	ND	0.213	ND	0.231
Uranium, Total **(μg/L)**	530	R	1.0	1.29	1.0	2.13
Pesticide/PCBs (μg/L)						
Alpha-Chlordane	0.31	R	-	ND	-	0.003
Aroclor-1254	0.20	D	-	ND	-	ND
Aroclor-1260	0.20	D	-	ND	-	ND
Dieldrin	0.020	D	-	ND	-	0.0095
Semi-Volatiles (μg/L)						
Benzo(a)anthracene	1.0	D	-	ND	-	ND
Benzo(a)pyrene	1.0	D	-	ND	-	ND
bis(2-Chloroisopropyl)ether	280	R	-	ND	-	ND
bis(2-Ethylhexyl)phthalate	8.4	A	-	2	-	2.5
Dibenzo(a,h)anthracene	1.0	D	-	ND	-	1.9
3,3'-Dichlorobenzidine	7.7	R	-	ND	-	ND

Table 4–2. Surface Water Selection Criteria Summary (continued)

Constituent[a]	FRL[b]	FRL Basis[b]	95th Percentile Background Level in Surface Water[c,d]			
			Paddys Run		Great Miami River	
			Original	Revised	Original	Revised
Semi-Volatiles (μg/L) (Cont.)						
Di-n-butylphthalate	6000	R	-	5.09	-	5.5
Di-n-octylphthalate	5.0	D	-	1.75	-	ND
p-Methylphenol	2200	R	-	ND	-	0.6
4-Nitrophenol	7,400,000	R	-	ND	-	ND
Volatiles (μg/L)	280	R				
Benzene	280	R	-	ND	-	0.35
Bromodichloromethane	240	R	-	ND	-	ND
Bromomethane	1300	R	-	ND	-	ND
Chloroform	79	A	-	0.782	-	0.3
1,1-Dichloroethene	15	R	-	ND	-	ND
Methylene chloride	430	A	-	1	-	ND
Tetrachloroethene	45	R	-	0.367	-	ND
1,1,1-Tricholoroethane	1.0	D	-	ND	-	ND
1,1,2-Tricholoroethane	230	R	-	ND	-	ND
Other Constituents						
Ammonia			-	0.14	-	0.176
Carbon disulfide			-	ND	-	0.35
Cobalt			-	-	-	0.0124
Trichloroethene			-	0.2	-	ND

[a]Shaded text indicates constituents selected in the past for IEMP surface water analysis at locations other than background and NPDES Permit sample locations.
[b]Derived from OU5 ROD, Table 9–5.
A = ARAR values
B = background concentrations
D = analytical detection limit
R = human health risk
[c]ND = non-detected result
\- = not applicable/not available
[d]For small data sets (less than or equal to seven samples), the maximum detected concentration is used as the 95th percentile.
[e]FRL based on chromium (VI); however, the analytical results are for total chromium.

- Column 3, FRL Basis: This column is the basis for establishment of the FRL as defined in the OU5 Feasibility Study.
- Column 4, Background Values in Surface Water: This column represents updated background values for Paddys Run and the Great Miami River based on data collected for the IEMP through 2006. The IEMP provides this information for purposes of comparison.

4.3.2.2 Surface Water Cross-Medium Impact

To assess the cross-medium impact that contaminated surface water has on the underlying Great Miami Aquifer, the following design considerations are necessary:

- Samples should be collected at those points near where the glacial overburden has been breached by site drainages. As described in the OU5 remedial investigation, the majority of the Fernald Preserve is underlain by clay rich glacial overburden. Where present, this glacial overburden provides a measure of protection to the underlying sand and gravel aquifer. However, the glacial overburden has been eroded by site drainages primarily in the lower reaches of Paddys Run and in the Storm Sewer Outfall Ditch (Figure 4–1). Pre design groundwater characterization activities in the former waste storage and former Plant 6 areas confirmed that an area in the Pilot Plant drainage ditch adjacent to Paddys Run should be considered as a primary source of infiltration. At these locations, a direct pathway exists for surface water and associated contaminants to reach the underlying sand and gravel Great Miami Aquifer.
- During remediation and restoration efforts, new wetlands and ponds were created within the site perimeter. Some of these water bodies have little or no underlying glacial overburden. Therefore, five additional surface water locations were selected to assess the possible impacts of surface water infiltrating into the aquifer. Sampling at these locations will occur semiannually for uranium for 2 years to evaluate potential impacts. Data will be evaluated to determine the need for further sampling following the initial 2-year period.
- Constituents analyzed should represent those area-specific COCs identified in the OU5 Feasibility Study and subsequent fate and transport modeling as having the potential for cross-medium impact to groundwater via the surface water pathway.

4.3.2.3 Sporadic Exceedances of FRLs

Sample locations should be located (1) on property locations downstream of historical FRL exceedances, (2) at the point where Paddys Run flows off the Fernald Preserve property, and (3) at the Parshall Flume (PF 4001), where treated effluent is discharged from the Fernald Preserve to the Great Miami River. (Refer to Figure 4–2 for IEMP surface water and treated effluent sample locations.) To determine the concentration of the treated effluent constituents outside the mixing zone in the Great Miami River, a conservative calculation using the 10-year, low-flow conditions is necessary requiring that flow conditions at the Hamilton Dam gauge be periodically reviewed.

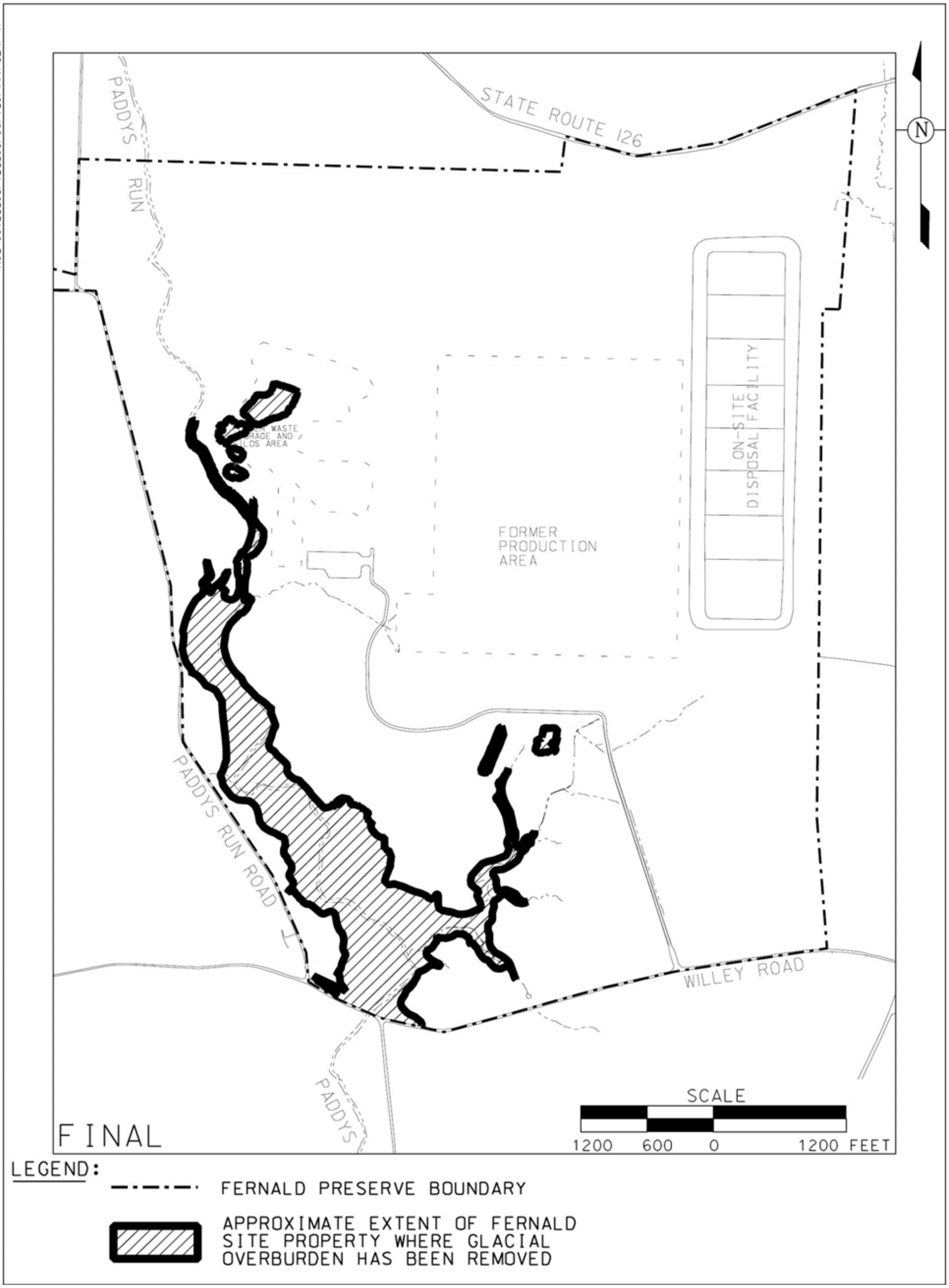

Figure 4–1. Area where Glacial Overburden Has Been Removed

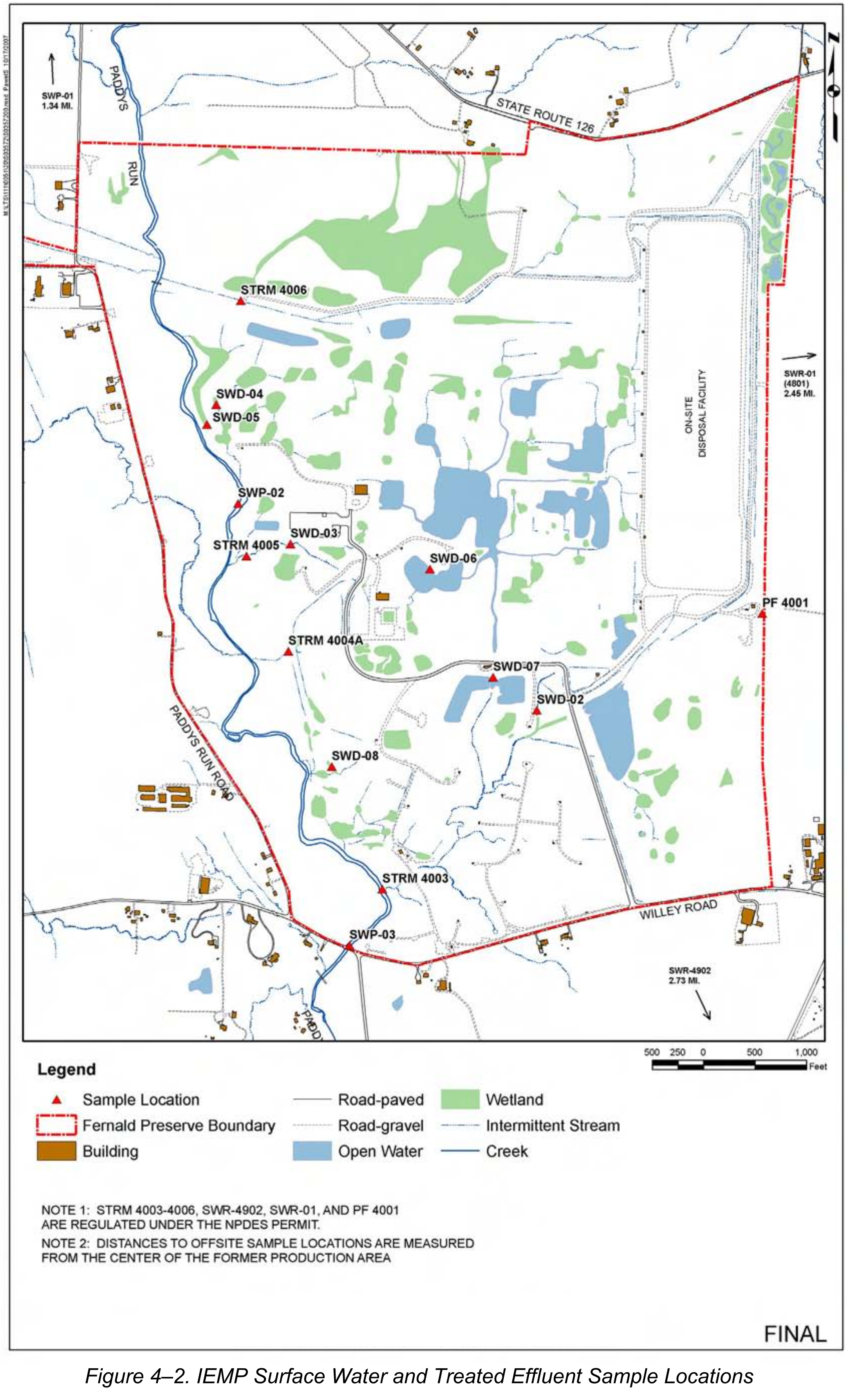

Figure 4–2. IEMP Surface Water and Treated Effluent Sample Locations

To assist in the development of the scope and focus of the IEMP surface water and treated effluent program, a review of the IEMP surface water data is conducted periodically. The last such review was based on data collected under the IEMP program from August 1997 through December 2006. The recommended parameters and locations for monitoring are indicated in Table 4–3 (i.e., IEMP Characterization). To provide surveillance monitoring for FRL exceedances, samples will be collected semiannually and analyzed for those constituents identified in Table 4–3.

Constituents are monitored at SWP 03 because it is the last location that surface water is monitored on Paddys Run prior to leaving the site and all non-radiological area specific constituents and uranium are monitored at this location in order to be conservative. Monitoring for radiological constituents at this location has been eliminated (with the exception of uranium) with the completion of remedial activities that eliminated the source of these contaminants. Data collected to date for these constituents further supports this decision. Appendix B provides maps detailing surface water locations with FRL exceedances including historical exceedances and those exceedances at background locations.

4.3.2.4 Impacts to Surface Water Due to Uncontrolled Storm Water Runoff

During remediation of the site, storm water runoff was collected and treated as necessary to ensure protection of human health and the environment. With remediation completed, there are no areas where storm water runoff is controlled, with the exception of the footprint of the CAWWT tankage located on a controlled pad. Therefore, all runoff is uncontrolled. However, IEMP surface water monitoring will continue at points of storm water runoff entry into receiving waters or within main site drainage ditches (in addition to ambient monitoring for background quantification purposes).

Figure 4–3 shows the dramatic effect past storm water runoff controls have had on lowering the concentrations of uranium, the principal site contaminant, in surface water leaving the site via Paddys Run. Other important distinctions regarding uranium in uncontrolled runoff from the site to Paddys Run, based on the data in Figure 4–3, include:

- Average concentrations have been far below the human/health protective surface water FRL concentration of 530 µg/L in each year since 1981. (This includes 9 years while the site was in production.)
- Annual average concentrations have been consistently below the human/health protective groundwater FRL of 30 µg/L since the previous Storm Water Retention Basin began collecting contaminated runoff in 1986.

Additional controls for storm water runoff may be required per the *Storm Water Pollution Prevention Plan* for construction activities.

Effective sampling points for this surveillance monitoring need to be:

- At points where storm water runoff from the Fernald property enters Paddys Run.
- At the Fernald Preserve boundary in Paddys Run.

Table 4–3. Summary of Surface Water and Treated Effluent Sampling Requirements by Location

Location	Constituent[a]	IEMP Characterization Requirements (reason for selection)[b,c]	NPDES Requirements[c]	OU5 ROD[c] Requirements
SWP-01 and SWR-01 (SWR-4801) (Paddys Run and Great Miami River Background)	**General Chemistry:**			
	Ammonia	-	Quarterly[d]	-
	Total hardness	-	Quarterly[d]	-
	Inorganics:			
	Beryllium	Semiannually (B)	-	-
	Cadmium	Semiannually (B)	Quarterly[d]	-
	Chromium, Total	Semiannually (B)	Quarterly[d]	-
	Cobalt	-	Quarterly[d]	-
	Copper	Semiannually (B)	Quarterly[d]	-
	Cyanide	Semiannually (B)	-	-
	Lead	-	Quarterly[d]	-
	Manganese	Semiannually (B)	Quarterly[d]	-
	Mercury	Semiannually (B)	Quarterly[d]	-
	Nickel	-	Quarterly[d]	-
	Silver	Semiannually (B)	Quarterly[d]	-
	Zinc	Semiannually (B)	Quarterly[d]	-
	Radionuclides:			
			-	-
	Uranium, Total	Semiannually(B)	-	-
SWP-02 (Paddys Run)	**Radionuclides:**			
	Uranium, Total	Semiannually (PC)	-	-
SWP-03 (Paddys Run at Downstream Property Boundary)	**Inorganics:**			
	Beryllium	Semiannually (S)	-	-
	Cadmium	Semiannually (S)	-	-
	Chromium, Total	Semiannually(S)	-	-
	Copper	Semiannually (S)	-	-
	Cyanide	Semiannually (M)	-	-
	Manganese	Semiannually(S)	-	-
	Mercury	Semiannually (M)	-	-
	Silver	Semiannually(M)	-	-
	Zinc	Semiannually (M)	-	-
	Radionuclides:			
	Uranium, Total	Semiannually (PC)	-	-

Table 4–3. Summary of Surface Water and Treated Effluent Sampling Requirements by Location (continued)

Location	Constituent[a]	IEMP Characterization Requirements (reason for selection)[b,c]	NPDES Requirements[c]	OU5 ROD[c] Requirements
SWD-02 (Storm Sewer Outfall Ditch)	**Radionuclides:**			
	Uranium, Total	Semiannually (PC)	-	-
SWD-03 (Waste Storage Area)	**Radionuclides:**			
	Uranium, Total	Semiannually(PC)	-	-
PF 4001 (Parshall Flume - Treated Effluent)	**General Chemistry:**			
	Ammonia	-	3/Week[e]	-
	Carbonaceous biochemical oxygen demand	-	2/Week	-
	Fluoride	-	Monthly	-
	Nitrate/Nitrite	-	Monthly	-
	Oil and grease	-	2/Week	-
	Total dissolved solids	-	Monthly	-
	Total residual chlorine	-	2/Week[f]	-
	Total suspended solids	-	Daily	-
	Inorganics:			
	Antimony	-	Monthly	-
	Arsenic	-	Monthly	-
	Barium	-	3/Week	-
	Beryllium	-	Monthly	-
	Boron	-	Monthly	-
	Cadmium	-	3/Week	-
	Chromium, Total	-	3/Week	-
	Cobalt	-	2/Week	-
	Copper	-	3/Week	-
	Cyanide	-	Monthly	-
	Lead	-	3/Week	-
	Manganese	-	2/Week	-
	Mercury	-	Monthly	-
	Molybdenum	-	3/Week	-
	Nickel	-	3/Week	-
	Selenium	-	3/Week	-
	Silver	-	3/Week	-
	Zinc	-	3/Week	-
PF 4001 (Parshall Flume - Treated Effluent) (Cont.)	**Radionuclides:**			
	Uranium, Total	Semiannually(PC)	-	Daily
	Semi-Volatiles:			
	Bis (2-ethylhexyl) phthalate	-	Quarterly	-
	Volatiles:			
	Chloroform	-	Quarterly	-
	1,1-Dichloroethane	-	Quarterly	-
	Trichloroethene	-	Quarterly	-
	Other:			
	Flow Rate	-	Daily	-

Table 4–3. Summary of Surface Water and Treated Effluent Sampling Requirements by Location (continued)

Location	Constituent[a]	IEMP Characterization Requirements (reason for selection)[b,c]	NPDES Requirements[c]	OU5 ROD[c] Requirements
STRM 4003, STRM 4004[g] STRM 4005, STRM 4006 (Drainages to Paddys Run)	**General Chemistry:**			
	Total suspended solids	-	Semiannually	-
	Inorganics:			
	Copper (4003, 4004, 4006)	-	Semiannually	-
	Lead (4004, 4005, 4006)	-	Semiannually	-
	Mercury	-	Semiannually	-
	Silver (4004, 4006)	-	Semiannually	-
	Radionuclides:			
	Uranium, Total	Semiannually(PC)	-	-
	Other:			
	Fecal coliform	-	Semiannually	-
	Flow Rate	-	Semiannually	-
SWD-04, SWD-05, SWD-06, SWD-07, SWD-08[h]	**Radionuclides:**			
	Uranium, Total	Semiannually	-	-
SWR-4902 (Downstream of Fernald Preserve Effluent)	**General Chemistry:**			
	Ammonia	-	Quarterly	-
	Total Hardness	-	Quarterly	-
	Inorganics			
	Cadmium	-	Quarterly	-
	Chromium	-	Quarterly	-
	Cobalt	-	Quarterly	-
	Copper	-	Quarterly	-
	Lead	-	Quarterly	-
	Manganese	-	Quarterly	-
	Mercury	-	Quarterly	-
	Nickel	-	Quarterly	-
	Silver	-	Quarterly	-
	Zinc	-	Quarterly	-

[a]Field parameter readings, taken at each location, include temperature, specific conductance, pH, and dissolved oxygen.
[b]B = background evaluation; M = based on modeling; PC = primary COC; S = sporadic exceedances of FRLs; WP = Waste Pits Excavation Monitoring
[c]"-" indicates the constituent is not included in the sample program.
[d]Refers only to location SWR-01 (NPDES location SWR-4801); constituents sampled quarterly.
[e]Sampled twice a week in winter (November 1 through April 30) and three times a week in summer (May 1 through October 31).
[f]Constituent not sampled from November through April.
[g]New location STRM 4004A has been identified as an alternative sample location for STRM 4004. STRM 4004A will be sampled for the constituents if no flow is observed at STRM 4004 or is otherwise not accessible.
[h]Sampling will be conducted for 2 years to determine if sampling should continue. Locations are based on sampling from Residual Risk Assessment Analysis and lack of glacial overburden.

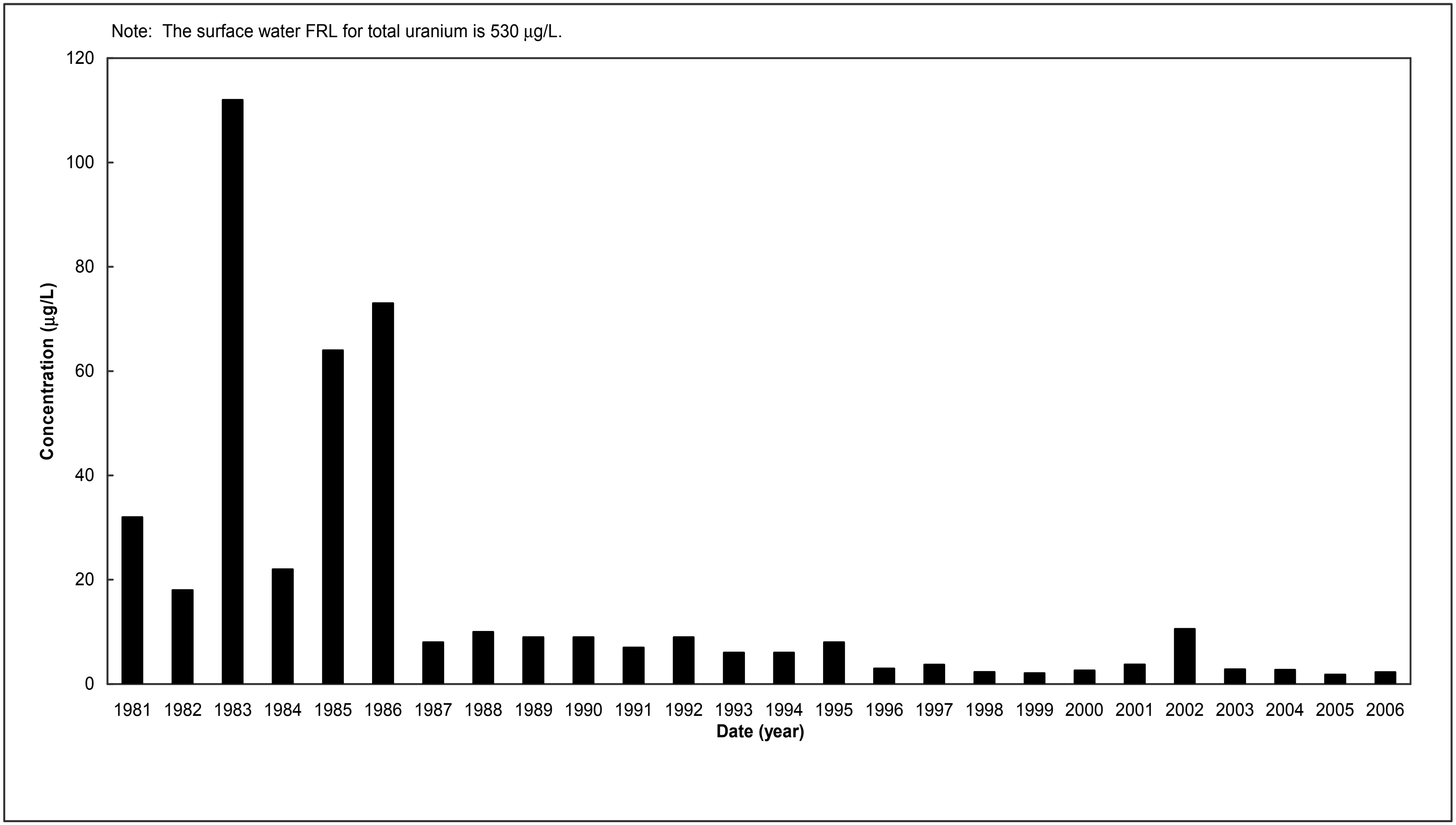

Figure 4–3. Comparison of Average Total Uranium Concentrations at Paddys Run at Willey Road Sample Location SWP-03

4.3.2.5 Ongoing Background Evaluation

Because the RI/FS background data set for Paddys Run and the Great Miami River surface water was limited by the number of samples and temporal variability represented by the samples, monitoring for surface water background has been performed from the initiation of the IEMP through 2004 for all 55 surface water FRL constituents. Although there are only 17 area-specific surface water constituents (i.e., constituents identified as being FRL concerns and monitored under the IEMP characterization program), the extensive list of 55 constituents was monitored at background in order to establish a robust data set. The more extensive list was monitored at background so that if soil sampling indicated the need to expand the list of 17 area-specific surface water constituents, there would be corresponding background data.

Since soil sampling did not indicate a need to add constituents to the list of 17 area-specific surface water constituents and due to the abundance of background data, the list of surface water constituents monitored at the background locations was reduced to coincide with the 17 area-specific constituents monitored for surface water FRLs beginning in 2005. Refer to Table 4–3 for background monitoring requirements; refer to Figure 4–4 for background surface water sample locations.

Additionally, it is anticipated that as part of surface water certification, background values along with FRL values will be compared to the concentrations at locations monitored for area-specific constituents. The recalculated background values based on IEMP data collected from August 1997 through 2006 is provided in Table 4–2.

4.3.2.6 Fulfill National Pollutant Discharge Elimination System Requirements

As noted in Section 4.2, wastewater and storm water discharges from the Fernald Preserve are regulated under the state-administered NPDES program. The current permit (OEPA Permit 1IO00004*GD) was issued on June 1, 2003, became effective on July 1, 2003, and expires on June 30, 2008. Figure 4–5 identifies the current NPDES Permit sample locations.

4.3.2.7 Fulfill Federal Facilities Compliance Agreement and OU5 ROD Requirements

As noted in Section 4.2.2, the current FFCA sampling and reporting requirements became effective on May 1, 1996. During post-closure, these requirements include sampling at the Parshall Flume (PF 4001) and the South Plume extraction wells. In addition to these sampling requirements, an estimate of the amount of uranium reaching Paddys Run via uncontrolled storm water runoff is calculated. The IEMP incorporates sampling of the Parshall Flume and total uranium calculations for uncontrolled storm water runoff and the Parshall Flume. Section 3.0 discusses sampling of the South Plume extraction wells. As discussed in Section 7.0, monitoring data required by the FFCA have been incorporated into the comprehensive IEMP reporting structure.

Based on the completion of remediation of each of the four source OUs, there is no longer a need to monitor any radiological constituent other than uranium—the primary site contaminant—at any of the proposed monitoring locations.

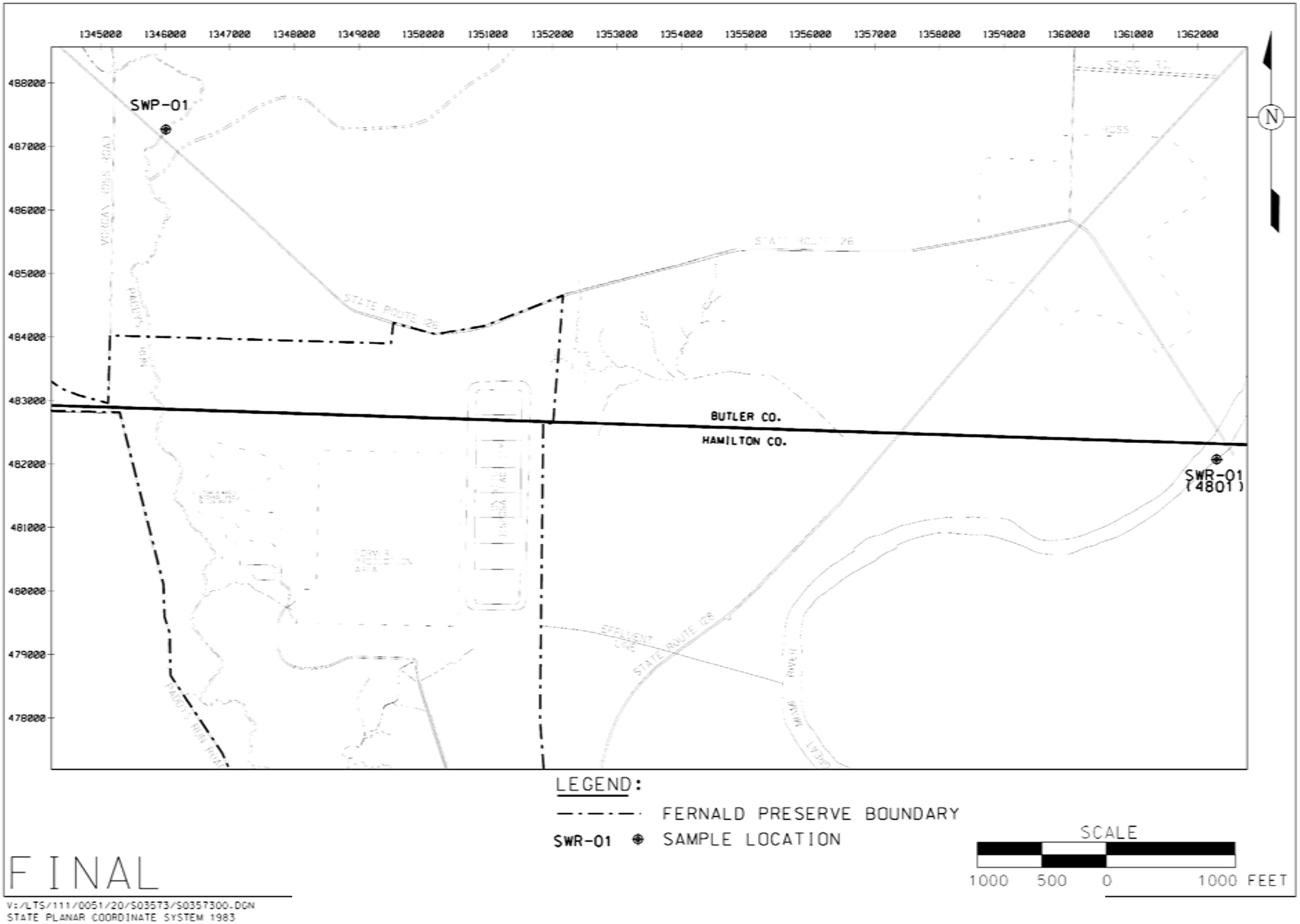

Figure 4–4. IEMP Background Surface Water Sample Locations

4.3.2.8 Fulfill DOE Order 450.1 requirements

The design considerations provided above, which were based on information and conclusions derived from the existing DOE-compliant environmental monitoring program as well as the comprehensive findings of the RI/FS process, are sufficient to meet or exceed the requirements of DOE Order 450.1 as summarized in Section 4.2.2.

4.3.2.9 Address Concerns of the Community

The monitoring derived from Section 4.3.2.4 will be sufficient to address the concerns of the community. These concerns focus on limiting the amount of Fernald Preserve-related contamination entering Paddys Run and the Great Miami River. This monitoring will provide a comprehensive monitoring program on Paddys Run at the facility boundary and in the treated effluent destined for the Great Miami River.

4.3.3 Program Design

This section provides the IEMP surface water and treated effluent sampling program developed from the design considerations provided in Section 4.3.2. Table 4–3 summarizes the program design by providing the sample locations, the frequency, and the constituents to be sampled for at each location. This table also provides the basis for the locations and constituents with respect to program expectations identified in Section 4.3.1. To simplify the presentation of the surface water and treated effluent program, the basis for IEMP characterization can be found in column 3 described as "(reason for selection)" in Table 4–3. This terminology is consistent with the approach used for reporting through the IEMP.

The non-radiological discharge monitoring and reporting related to the NPDES Permit has been incorporated into the IEMP. The radiological discharge monitoring related to the FFCA and OU5 ROD has been incorporated into the IEMP. Near the completion of site remediation, sampling will occur to certify that the surface water pathway at the Fernald Preserve is meeting the obligations set forth in the OU5 ROD.

4.4 Medium-Specific Plan for Surface Water and Treated Effluent Sampling

This section serves as the medium-specific plan for implementation of the sampling, analytical, and data management activities associated with the IEMP surface water and treated effluent sampling program. The activities described in this medium-specific plan were designed to provide surface water and treated effluent data of sufficient quality to meet the program expectations as stated in Section 4.3.1. The program expectations, along with the design considerations presented in Section 4.3.2, were used as the framework for developing the monitoring approach presented in this plan. All sampling procedures and analytical protocols described or referenced herein are consistent with the requirements of the LM QAPP.

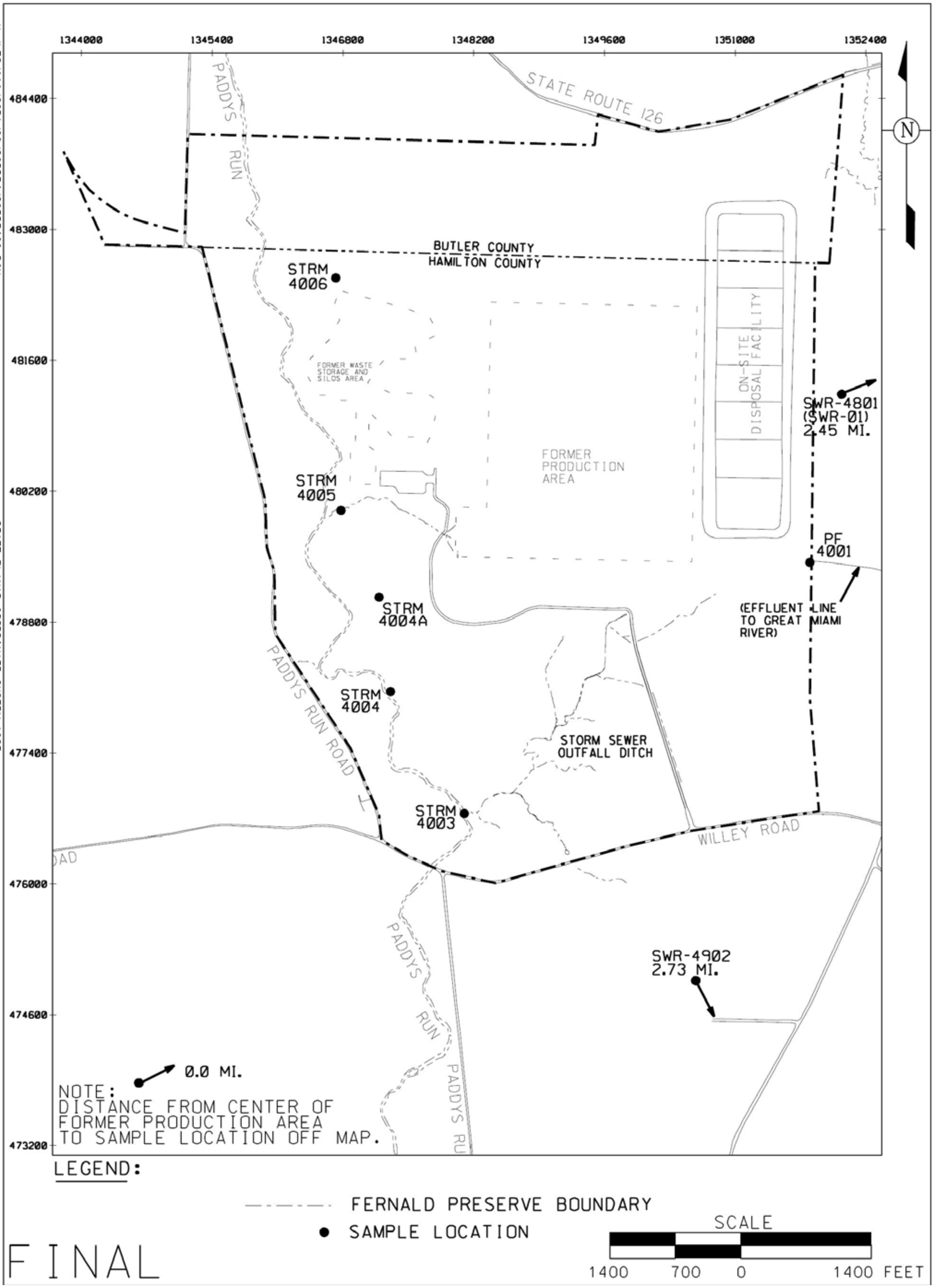

Figure 4–5. NPDES Permit Sample Locations

Subsequent sections of this medium-specific plan define the following:

- Project organization and associated responsibilities
- Sampling program
- Change control
- Health and safety
- Data management
- Project quality assurance

4.4.1 Project Organization

A multidiscipline project organization has been established and assigned responsibility to effectively implement and manage the project planning, sample collection and analysis, and data management activities directed in this medium-specific plan. Following are the key positions and associated responsibilities required for successful implementation.

The project team leader will have full responsibility and authority for the implementation of this medium-specific plan in compliance with all regulatory specifications and site-wide programmatic requirements. Integration and coordination of all medium-specific plan activities defined herein with other project groups is also a key responsibility. All changes to project activities must be approved by the project team leader or designee.

Health and safety are the responsibility of all individuals working on this project scope. Qualified health and safety personnel shall participate on the project team to assist in preparing and obtaining all applicable permits. In addition, safety specialists shall periodically review and update the project-specific health and safety documents and operating procedures, conduct pertinent safety briefings, and assist in evaluation and resolution of all safety concerns.

Quality assurance personnel will participate on the project team, as necessary, to review project procedures and activities ensuring consistency with the requirements of the LM QAPP or other referenced standard and assist in evaluating and resolving all quality-related concerns.

4.4.2 Sampling Program

To fulfill the requirements of the integrated surface water and treated effluent program, surface water and treated effluent samples shall be collected from locations shown in Figures 4–2, 4–4, and 4–5. Table 4–3 summarizes the surface water and treated effluent sampling frequency and location-specific analytical suites. Tables 4–4 and 4–5 provide the sample collection and analytical method information for these locations and constituents.

Sample analysis will be performed either on site or at off-site contract laboratories, depending on specific analyses required, laboratory capacity, turnaround time, and performance of the laboratory. The laboratories used for analytical testing have been audited to ensure that DOECAP or equivalent process requirements have been met as specified in LM QAPP. These criteria include meeting the requirements for performance evaluation samples, pre-acceptance audits, performance audits, and an internal quality assurance program.

Table 4–4. Surface Water Analytical Requirements for Constituents at Sample Locations SWD-02, SWD-03, SWD-04, SWD-05, SWD-06, SWD-07, SWD-08, SWP-01[a], SWP-02, SWP-03, AND SWR-01[a]

Constituent	Analytical Method	ASL[b]	Holding Time	Preservative	Container
Inorganics:					
Beryllium Cadmium Chromium, Total Copper Manganese Silver Zinc	7000A[c], 3500[d], 6020[c], or 6010B[c]	B	6 months	HNO_3 to pH <2	Plastic or glass
Mercury	7470A[c]	B	28 days	HNO_3 to pH <2	Plastic or glass
Cyanide, Total	9010B[c], 9012[c], 335.2[e], or 335.3[e]	B	14 days	Cool 4°C, NaOH to pH >12	Plastic or glass
Radionuclides:					
Uranium, Total	DOE-EML HASL 300[f]	B	6 months	HNO_3 to pH <2	Plastic or glass
Field Parameters[g]:	LM SAP & LM QAPP[h]	A	NA[i]	NA[i]	NA[i]

Note: The analytical site-specific contract identifies the specific method.
Note: Only sample locations SWP-01 and SWR-01 are analyzed for all constituents listed in this table. The remaining sample locations are analyzed for a subset of these constituents (summarized in Table 4–3).
[b]The ASL may become more conservative if it is necessary to meet detection limits or data quality objectives.
[c]Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
[d]Standard Methods for the Examination of Water and Wastewater
[e]Methods for Chemical Analysis of Water and Wastes
[f]Procedures Manual of the Environmental Measurements Laboratory .
[g]Field parameters include temperature, specific conductance, pH, and dissolved oxygen.
[h]The LM SAP & LM QAPP provide field methods.
[i]NA = not applicable

4.4.2.1 Sampling Procedures

Specific sampling procedures associated with surface water and treated effluent will be performed in accordance with directives established in the LM SAP and the LM QAPP.

<u>Surface Water Sampling</u>
Surface water samples will be collected from locations in Paddys Run, drainage ditches to Paddys Run, and the Great Miami River. A qualitative assessment of flow conditions (i.e., base flow, storm flow, or between storm and base flow) will be documented at the time of sample collection at each of these locations. Sampling personnel will ensure that access to the sample locations will not result in the inadvertent introduction of foreign materials into the water sample. Additional precautions will be taken to avoid the introduction of floating organic material such as leaves or twigs during sample collection. Samples will be collected without disturbing bottom sediment. Sample technicians shall approach sample locations from downstream of the location; if sample locations are accessed by way of a bridge, samples shall be collected on the upstream side of the bridge.

Table 4–5. Surface Water and Effluent Analytical Requirements for Constituents at Sample Locations PF 4001, STRM 4003, STRM 4004, STRM 4005, STRM 4006, SWR-4801, and SWR-4902

Constituent[a]	Analytical Method[b]	Sample Type[c]	ASL[b,d]	Holding Time[b]	Preservative[b]	Container[b]
General Chemistry:						
Ammonia	350.1[e], 350.3[e], 4500C[f], or 4500F[f]	Composite or Grab[g]	B	28 days	Cool 4°C, H_2SO_4 to pH <2	Plastic or glass
Carbonaceous biochemical oxygen demand	5210B[f]	Composite	B	48 hours	Cool 4EC	Plastic or glass
Chlorine, residual	4500[f]	Grab	B	Analyze immediately	None	Plastic or glass
Fluoride	300.0[e], 340.2[e], 4500C[f]	Composite	B	28 days	None	Plastic or glass
Nitrate/Nitrite	353.1[e], 353.2[e], 353.3[e], 4500D[f], or 4500E[f]	Composite	B	28 days	Cool 4°C, H_2SO_4 to pH <2	Plastic or glass
Oil and grease	1664A[i] or 5520B[f]	Grab	B	28 days	Cool 4°C, H_2SO_4 to pH <2	Glass
Total dissolved solids	160.1[e] or 2540C[f]	Grab	B	7 days	Cool 4°C	Plastic or glass
Total hardness	2340C[f]	Grab	B	28 days	Cool 4°C, H_2SO_4 to pH <2	Plastic
Total suspended solids	160.2[e] or 2540D[f]	Composite	B	7 days	Cool 4°C	Plastic or glass
Inorganics:						
Antimony	6020[h], 7000A[h], 3500[f], 6010B[h], 200.8[j], 220.2[e], or 272.2[e]	Composite or Grab[g]	B	6 months	HNO_3 to pH <2	Plastic or glass
Arsenic						
Barium						
Beryllium						
Boron						
Cadmium						
Chromium, Total						
Cobalt						
Copper						
Lead						
Manganese						
Molybdenum						
Nickel						
Selenium						
Silver						
Zinc						
Mercury	7470A[h] or 1631[e,k]	Grab	B	28 days	HNO_3 to pH <2	Plastic or glass
Cyanide, Free	335.1[e] or 4500-CNG[f]	Grab	B	14 days	Cool 4°C, NaOH to pH >12	Plastic or glass

Table 4–5. Surface Water and Effluent Analytical Requirements for Constituents at Sample Locations PF 4001, STRM 4003, STRM 4004, STRM 4005, STRM 4006, SWR-4801, AND SWR-4902 (continued)

Constituent[a]	Analytical Method[b]	Sample Type[c]	ASL[b,d]	Holding Time[b]	Preservative[b]	Container[b]
Radionuclides:						
Uranium, Total	DOE-EML HASL 300[l]	Composite[m]	B	6 months	HNO_3 to pH <2	Plastic or glass
Semi-Volatiles:						
Bis(2-ethylhexyl)phthalate	625[n]	Grab	B	**7** days to extraction 40 days from extraction to analysis	Cool 4°C	Glass (amber with Teflon-lined cap)
Volatiles:						
Trichloroethene	624[n]	Grab	B	14 days	H_2S0_4 pH <2 Cool 4EC	Glass (with Teflon-lined septum cap)
Chloroform						
1,1-Dichloroethane						
Other:						
Fecal coliform	9222D[f]	Grab	B	6 hours	Cool 4°C	Plastic or glass (sterile)
Flow rate	NA	24 hour total	NA	NA	NA	NA
Field Parameters[o]	LM SAP & LM QAPP[p]	Grab	A	NA	NA	NA

Note: The analytical site-specific contract identifies the specific method.
[a]This represents a comprehensive list of constituents taken from the indicated list of surface water and treated effluent monitoring locations. Each location will be analyzed for a subset of these constituents (summarized in Table 4–3).
[b]NA = not applicable
[c]For composite samples at PF 4001, a flow-weighted composite sample collected over a 24-hour period; for STRM 4003, STRM 4004, STRM 4005, and STRM 4006, composite samples shall be comprised of four samples collected at intervals of at least 30 minutes but not more than 2 hours.
[d]The ASL may become more conservative if necessary to meet detection limits or data quality objectives.
[e]Methods for Chemical Analysis of Water and Wastes
[f]Standard Methods for the Examination of Water and Wastewater
[g]Grab samples are collected at locations SWR-4801 and SWR-4902 for this constituent.
[h]Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
[i]Method 1664, Revision A: N-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM; Non-Polar material) by Extraction and Gravimetry.
[j]Methods for the Determination of Metals in Environmental Samples
[k]Method 1631 for mercury analysis will only be used at NPDES Permit locations where mercury sampling is required.
[l]Procedures Manual of the Environmental Measurements Laboratory.
[m]Total uranium is a grab sample at STRM 4003, STRM 4004, STRM 4005, and STRM 4006 and a composite sample at all other locations.
[n]40 CFR 136, Appendix A
[o]Field parameters include dissolved oxygen, pH, specific conductance, and temperature.
[p]The LM SAP & LM QAPP provide field analytical methods.

Samples will be collected using the methods outlined in the LM SAP including the collection method, container, preservative, and documentation. Tables 4–4 and 4–5 identify the sample preservative, volume, and container requirements for each constituent.

Treated Effluent Sampling

Treated effluent will be collected by means of flow-proportional samplers at the Parshall Flume. Sampling will be conducted according to the LM SAP and the LM Fernald operational procedures (DOE 2006e).

After every 24 hours of operation, the collected liquid is removed from the automatic sampler to provide a daily flow-weighted sample of the treated effluent. A portion of each daily sample is analyzed to determine the estimate of total uranium discharged to the Great Miami River for the day. The Parshall Flume will be analyzed for the constituents listed in Table 4–3 for the respective locations. Table 4–5 lists the sample preservative, volumes, container requirements, and analytical methods for each constituent.

4.4.2.2 Quality Control Sampling Requirements

Quality control samples will be taken according to the frequency recommended in the LM SAP and LM QAPP. These samples will be collected and analyzed in order to evaluate the possibility that some controllable practice, such as sampling technique, may be responsible for introducing bias in the project's analytical results. Quality control samples will be collected as follows:

- A duplicate sample shall be collected each quarter at a randomly selected sample location.
- Trip blanks will be prepared and placed in coolers containing samples for volatile organic compound analysis and shall accompany the samples from collection to receipt at the laboratory.

For low-level mercury all-field sampling equipment will be sent to the off-site laboratory for decontamination and certification of cleanliness via rinsate analysis (equipment blank analysis) before reuse. In addition, trip blanks and field blanks will be supplied by the off-site laboratory and shall accompany the samples from collection to receipt at the laboratory.

4.4.2.3 Decontamination

In general, decontamination of equipment is minimized because reusable equipment is not used during sample collection. However, if decontamination is required, then equipment will be cleaned between sample locations. The decontamination is identified in the LM QAPP and more specifically outlined in the LM SAP. Sampling bailers used in sampling for mercury at NPDES Permit locations will be decontaminated at a contract laboratory.

4.4.2.4 Waste Dispositioning

Contact waste that is generated by the field technicians during field sampling activities are collected, maintained, and dispositioned, as necessary.

4.4.3 Change Control

Changes to the medium-specific plan will be at the discretion of the project team leader. Prior to implementation of field changes, the project team leader or designee shall be informed of the proposed changes and circumstances substantiating the changes. Any changes to the medium-specific plan must have written approval by the project team leader or designee, quality assurance representative, and the field manager prior to implementation. If a Variance/Field Change Notice is required, it will be completed in accordance with the LM QAPP. The Variance/Field Change Notice form shall be issued as controlled distribution to team members and will be included in the field data package to become part of the project record. During revisions to the IEMP, Variance/Field Change Notices will be incorporated to update the medium-specific plan.

4.4.4 Health and Safety Considerations

The Fernald Preserve's health and safety personnel are responsible for the development and implementation of health and safety requirements for this medium-specific plan. Hazards (physical, radiological, chemical, and biological) typically encountered by personnel when performing the specified fieldwork will be addressed during team briefings. Health and safety requirements are addressed in the Fernald Preserve Project Safety Plan.

All involved personnel will receive adequate training to the health and safety requirements prior to implementation of the fieldwork required by this medium-specific plan. Safety meetings will be conducted prior to beginning fieldwork to address specific health and safety issues.

4.4.5 Data Management

Field documentation and analytical results will meet the IEMP data reporting and quality objectives; they will also comply with the LM QAPP, the *LM Standard Practice for Validation of Laboratory Data*, and the LM SAP.

Data documentation and validation requirements for data collected for the IEMP fall into two categories depending upon whether the data are field- or laboratory-generated. Field data validation will consist of verifying medium-specific plan compliance and appropriate documentation of field activities. Laboratory data validation will consist of verifying that data generated are in compliance with medium-specific, plan-specified ASLs. Specific requirements for field data documentation and validation and laboratory data documentation and validation are in accordance with the LM QAPP, the *Standard Practice for Validation of Laboratory Data*, and the LM SAP.

There are five analytical levels (ASL A through ASL E) defined for use at the Fernald Preserve. For surface water, field data documentation will be at ASL A and laboratory data documentation will be at ASL B. A more conservative ASL may be required for laboratory data in order to meet required detection limits or in order to ensure data quality objectives. ASL B provides qualitative, semi-qualitative, and quantitative data with some quality-assurance/quality-control checks.

At a minimum, 10 percent of the IEMP data will undergo validation to ensure that analytical data are in compliance with the ASL method criteria being requested and in order to meet data quality objectives. The percentage of data validated could increase in order to meet data quality objectives.

Data will be entered into a controlled database using a double key or verification method to ensure accuracy. The hard-copy data will be managed in the project file in accordance with LM record keeping requirements and DOE Orders.

4.4.6 Quality Assurance

Assessments of work processes shall be conducted to verify quality of performance and may include audits, surveillances, inspections, tests, data verification, field validation, and peer reviews. Assessments shall include performance-based evaluation of compliance to technical and procedural requirements and corrective action effectiveness necessary to prevent defects in data quality. Assessments may be conducted at any point in the life of the project. Assessment documentation shall verify that work was conducted in accordance with IEMP, LM SAP, and LM QAPP requirements.

Recommended semiannual quality assurance assessments or surveillances shall be performed on tasks specified in the medium-specific plan. These assessments may be in the form of independent assessments or self-assessments, with at least one independent assessment conducted annually. Independent assessments are the responsibility of quality assurance personnel. The project team leader and quality assurance personnel will coordinate assessment activities and comply with the LM QAPP. The project or quality assurance personnel shall have "stop work" authority if significant adverse effects to quality conditions are identified or work conditions are unsafe.

4.5 IEMP Surface Water and Treated Effluent Monitoring Data Evaluation and Reporting

This section provides the methods for analyzing the data generated by the IEMP surface water and treated effluent sampling program. This section summarizes the data evaluation process and actions associated with various monitoring results. The planned reporting structure for IEMP-generated surface water and treated effluent data, including specific information to be reported in the annual site environmental report, is also provided.

4.5.1 Data Evaluation

Data resulting from the IEMP surface water and treated effluent program will be evaluated to meet the program expectations identified in Section 4.3.1. Based on these expectations, the following questions will be answered through the surface water and treated effluent data evaluation process, as indicated:

- Are surface water contaminant concentrations such that cross-medium impacts to the underlying aquifer could be expected?

Data from sample locations near areas where the glacial overburden is breached by site drainages will be compared to surface water and groundwater FRLs to assess potential impacts to the Great Miami Aquifer. Basic statistics, such as the minimum, maximum, and mean, will be generated yearly. The data generated from individual sampling events will be trended by sample location over time via graphical and, if necessary, statistical methods when sufficient data become available. Should trends above the historical ranges or above FRLs be observed, actions shown in Figure 4–6 will be implemented.

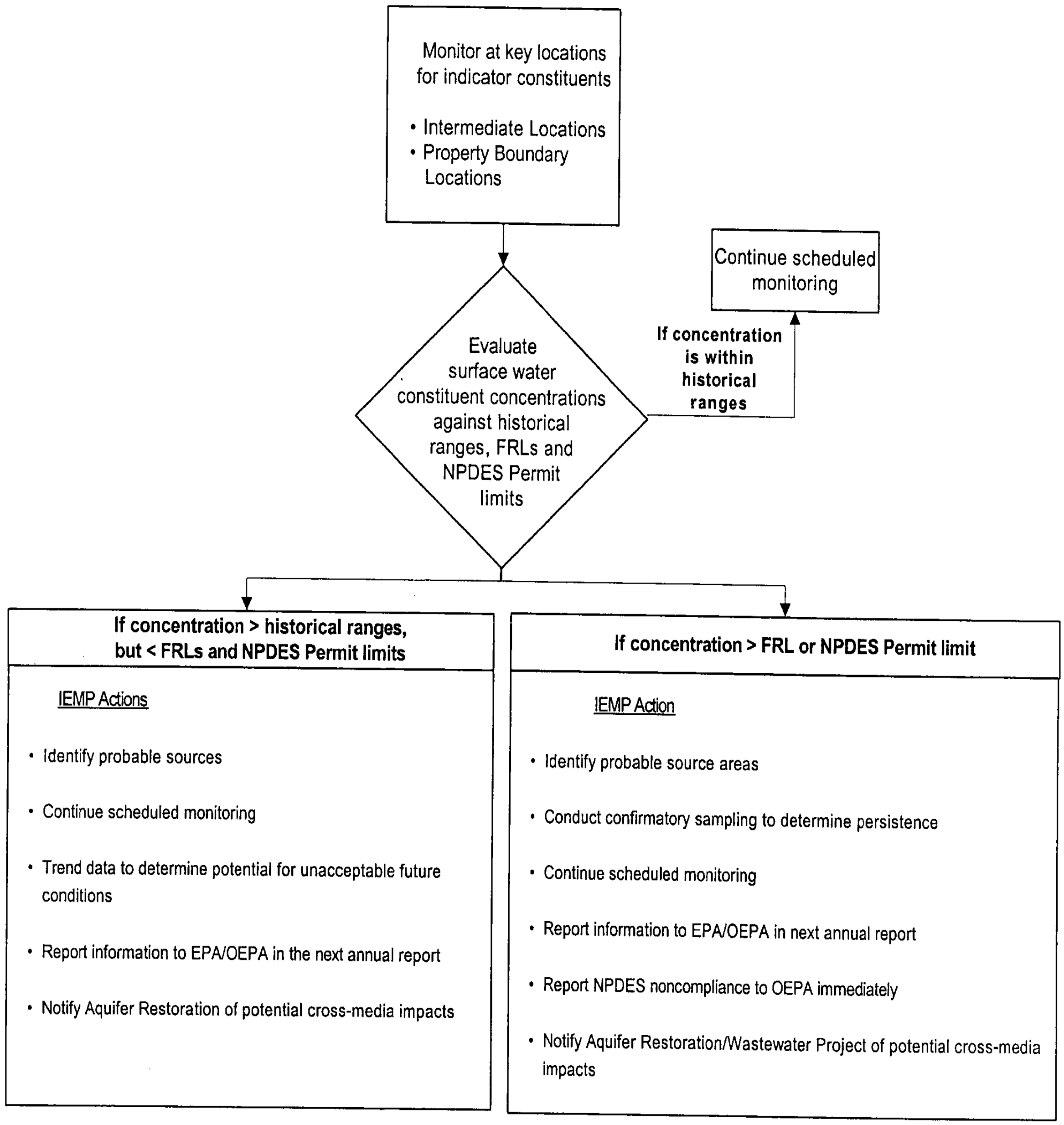

Figure 4–6. IEMP Surface Water Data Evaluation and Associated Actions

The personnel responsible for the restoration of the Great Miami Aquifer will be informed so that any potential adverse cross-medium impacts can be factored into the site groundwater remedy. Decision-making process described in Figure 4–6 can be implemented as necessary.

- Do the sporadic exceedances of FRLs continue to occur, decrease, or increase?

  Data evaluation will consist of direct comparison of data to FRLs. It is anticipated that it will be possible to reduce the list of constituents monitored with respect to FRLs (i.e., IEMP Characterization Monitoring).

- Has storm water runoff caused an undue adverse impact to the surface water or treated effluent?

  Trend analyses of data will be used to identify trends that may require further investigation of activities occurring within the drainage basin (or basins).

- Are the requirements of the NPDES Permit being fulfilled?

  Data collected to fulfill the site NPDES Permit requirements will be evaluated for compliance with the NPDES Permit provisions. This evaluation will serve to identify if immediate reporting of noncompliances to OEPA is necessary, and to determine the appropriate corrective action to address the noncompliance.

- Are the FFCA and OU5 ROD reporting requirements being fulfilled?

  Radiological discharges to the Great Miami River and Paddys Run are regulated by the FFCA and OU5 ROD. Reporting for these requirements have been incorporated into the IEMP reporting structure and include a cumulative summary of pounds of total uranium discharged and the monthly average total uranium concentration discharged to the Great Miami River.

- Are the program and reporting requirements of DOE Order 450.1 being met?

  DOE Order 450.1 requires that DOE implement and report on an environmental protection program for the Fernald Preserve. The surface water and treated effluent monitoring program is one component of the site-wide IEMP monitoring program. This IEMP and the annual site environmental report fulfill the requirements of this DOE Order.

- Are community concerns being met through the surface water and treated effluent IEMP program?

  The IEMP fulfills the needs of the Fernald community by preparing surface water and treated effluent environmental results in the annual site environmental report. DOE makes these reports available to the public at the Public Environmental Information Center. The specific community concern of the magnitude of Fernald Preserve discharges to Paddys Run and the Great Miami River is addressed in the annual site environmental report in the surface water and treated effluent section.

4.5.2 Reporting

The IEMP surface water and treated effluent program meets the reporting requirements for the NPDES Permit and the FFCA and OU5 ROD. The IEMP surface water, treated effluent, and quarterly FFCA data will be reported in the annual site environmental report and on the DOE-LM website at http://www.lm.doe.gov/land/sites/oh/fernald/fernald.htm. Additional information on IEMP data reporting is provided in Section 7.0.

The annual site environmental report will be issued each June. This comprehensive report will discuss a year of IEMP data previously reported on the DOE-LM website. The annual site environmental report will include the following:

- An annual summary of data from the IEMP surface water and treated effluent monitoring program.
- Constituent concentrations for each sample location.
- Statistical analysis summary for constituents, as warranted by data evaluation.
- Status of FFCA and OU5 ROD Great Miami River effluent limits, to be presented graphically showing status of compliance with the 30-µg/L and 600-pound total uranium limits.
- Status of regulatory compliance of the NPDES Permit.
- Actions taken to mitigate unacceptable surface water conditions revealed by the IEMP surface water sampling program.
- Observed trends and results of the data comparison to FRLs.

Because the IEMP is a living document, a structured schedule of annual reviews and 5-year revisions has been instituted. The annual review cycle provides the mechanism for identifying and initiating any surface water and treated effluent program modifications (i.e., changes in constituents, locations, or frequencies) that are necessary. Any program modifications that may be warranted prior to the annual review would be communicated to EPA and OEPA.

End of current text

5.0 Sediment Monitoring Program

Section 5.0 discusses the monitoring strategy for assessing the impact on sediments. This plan discusses the IEMP sampling design. In addition a medium-specific plan for sediment monitoring activities, a discussion of sediment data evaluation and the reporting structure are also provided.

5.1 Integration Objectives for the Sediment Monitoring Program

The design considerations for the IEMP sediment monitoring program (discussed in Section 5.3), especially the location of sample points, incorporate information from previous site sediment programs including the IEMP data and information regarding site controls that are in place.

Historically, the site-wide sediment pathway has been evaluated under the site's initial environmental monitoring program that began in 1974, and the RI/FS characterization of sediment that focused on a broader range of constituents (both radiological and non-radiological) in site drainages. The information produced by these programs through 1993 was reported and evaluated in the Remedial Investigation Report for OU5 and carried forward into the feasibility study report for OU5 for the development of sediment cleanup levels. The ROD for remedial actions at OU5 established health-protective FRLs for sediment. Off-property sediment from the Great Miami River is the focus of post-closure monitoring, since on-property sediments were certified as "clean" in 2006.

5.2 Analysis of Regulatory Drivers, DOE Policies, and Other Fernald Preserve Site-Specific Agreements

This section presents an evaluation of the regulatory drivers governing sediment monitoring during post-closure. The intent of this section is to identify any pertinent regulatory requirements, including ARARs and to-be-considered requirements, for the sediment monitoring program. These requirements will be used to confirm that the design specifications satisfy the regulatory obligations stated below and will achieve the intentions of other pertinent criteria, such as DOE Orders and the Fernald Preserve's existing agreements. The results of the evaluation also are used to define, as appropriate for these media, the programmatic boundaries between the IEMP and project-specific emissions control monitoring conducted by individual project organizations.

5.2.1 Approach

The analysis of the regulatory drivers and policies was conducted by examining the approved CERCLA RODs to identify any sediment-specific monitoring requirements.

5.2.2 Results

The evaluation of regulatory drivers for sediment monitoring resulted in two regulatory requirements governing the technical scope and reporting for the IEMP sediment monitoring program as well as project-specific monitoring of sediment:

- The CERCLA ROD for remedial actions at OU5 requires remediation of the site such that the sediment pathway is protective of the underlying Great Miami Aquifer and environmental receptors. The FRLs for sediment are specified in the OU5 ROD; however, a specified volume or area of sediment to be remediated was not identified due to the sporadic and isolated detections of contaminants above sediment FRLs. Attainment of sediment FRLs for on-property sediments was achieved as part of the Stream Corridors Project. An attainment of sediment FRLs for the Great Miami River sediments will be achieved by monitoring at the end of remediation activities, as committed to in the feasibility study report for OU5.
- Per the CERCLA Remedial Design Work Plan for remedial actions at OU5, monitoring will be conducted following the completion of cleanup as required to assess the continued protectiveness of the remedial actions. The IEMP will specify the type and frequency of environmental monitoring activities to be conducted following the cessation of remedial operations as appropriate. The IEMP will delineate the Fernald Preserve's responsibilities for site-wide monitoring of surface water and sediment over the life of the remedy, and ensure that FRLs are achieved at project completion.
- The CERCLA Feasibility Study Report for OU5 stated that if the concentrations of constituents remain above sediment BTVs after completion of the remedial action, then further investigation and remediation might be warranted. The sediment benchmark toxicity values (BTVs) listed in the Feasibility Study Report for OU5 were identified as contaminant concentrations that are protective of ecological receptors.

DOE Order 450.1, *Environmental Protection Program*, and DOE Order 5400.5, *Radiation Protection of the Public*, were also evaluated for any to-be-considered criteria that may drive environmental monitoring of sediment. This evaluation concluded that although sediment sampling has been conducted under previous sampling based on DOE Orders, continued sediment monitoring is not mandated by DOE Orders in light of the current site conditions, completed actions regarding IEMP surface water sampling, and the completed sediment verification sampling both on and off property.

Table 5–1 lists the regulatory drivers for sediment monitoring. Sections 5.5 and 7.0 provide the plan for the evaluation and reporting of sediment monitoring data.

Table 5–1. Fernald Preserve Sediment Monitoring Program Regulatory Drivers and Responsibilities

	DRIVER	ACTION
IEMP	OU5 Feasibility Study/OU5 ROD	The IEMP will be modified toward completion of the remedial actions to include sampling to verify FRL achievement.

5.3 Program Expectations and Design Considerations

5.3.1 Program Expectations

The expectations for the sediment sampling program are to:

- Continue monitoring two sample locations in the Great Miami River to confirm that the river is not being impacted by the Fernald Preserve, including treated discharges from the outfall line.

The IEMP sediment program is limited to the Great Miami River sample locations. Continued compliance with the Fernald Preserve's NPDES discharge limits precludes any discharge or accumulation of contaminated sediment in the river. It is anticipated that both the verification sampling and historical information from the Great Miami River will confirm that remediation of sediment in the Great Miami River is unnecessary along with fulfilling the OU5 Feasibility Study conclusion/recommendation.

5.3.2 Design Considerations

Based on the sediment data over the past 14 years, sediments from the Fernald Preserve do not currently pose a risk to the public. Since 1991, the only sediment FRL exceedance occurred in a 1996 sediment sample from the storm sewer outfall ditch for thorium-232 (sample result of 1.8 picocuries per gram [pCi/g] versus the FRL of 1.6 pCi/g).

Consistent with recent years, samples will be collected annually from the two locations on the Great Miami River: one downstream from the outfall line and one background location (Figure 5–1).

5.4 Medium-Specific Plan for Sediment Monitoring

This section serves as the medium-specific plan for implementation of the sampling, analytical, and data management activities associated with the IEMP sediment monitoring program. This plan pertains to those samples to be collected from the Great Miami River.

The activities described in this medium-specific plan were designed to provide sediment data of sufficient quality to meet the program expectations and design as stated in Sections 5.3.1 and 5.3.2. All sampling procedures and analytical protocols described or referenced herein are consistent with the requirements of the LM QAPP.

Subsequent sections of this medium-specific plan define the following:

- Project organization and associated responsibilities
- Sampling program
- Change control
- Health and safety
- Data management
- Project quality assurance

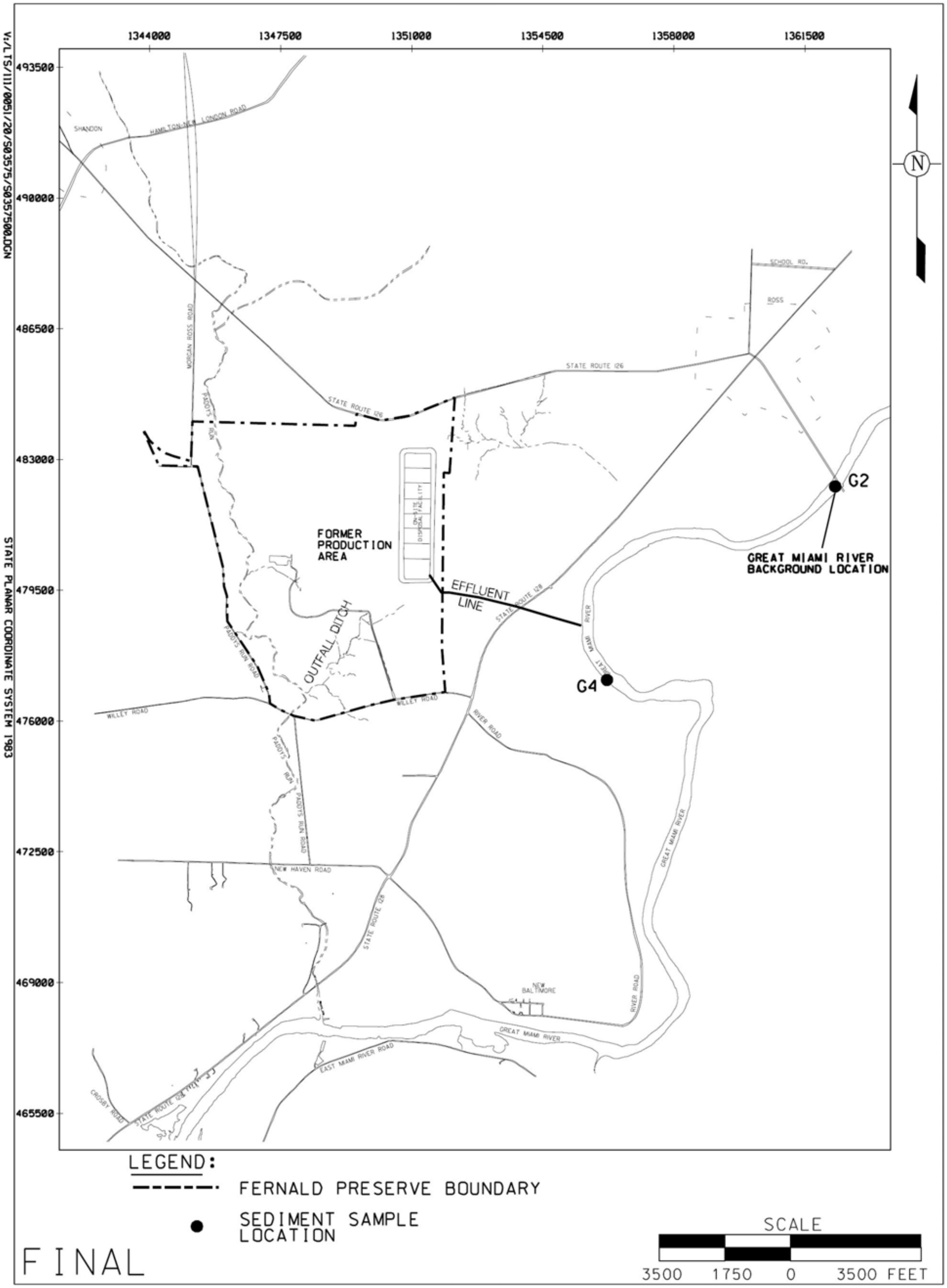

Figure 5–1. Sediment Sample Locations

5.4.1 Project Organization

The project team leader will have full responsibility and authority for the implementation of this medium-specific plan, in compliance with all regulatory specifications and site-wide programmatic requirements. All changes to project activities must be approved by the project team leader or designee.

Health and safety are the responsibility of all individuals working on this project scope. Qualified health and safety personnel shall participate on the project team to assist in preparing and obtaining all applicable permits. In addition, safety specialists shall periodically review and update the project-specific health and safety documents and operating procedures, conduct pertinent safety briefings, and assist in evaluation and resolution of all safety concerns.

Quality assurance personnel will participate on the project team, as necessary, to review project procedures and activities ensuring consistency with the requirements of the LM QAPP or other referenced standards, and to assist in evaluating and resolving all quality-related concerns.

5.4.2 Sampling Program

Sediment samples will be collected from two locations on the Great Miami River, typically in the summer or fall. Sampling is usually performed in this time period in order to take advantage of the abundance of fresh sediment deposited during flood conditions that commonly occur after the winter and spring seasons, and to enable sampling during low-flow or dry conditions. Sampling at other times of the year is also acceptable although sample collection may be more difficult due to water flow.

Figure 5–1 depicts the two IEMP sediment sample locations. Table 5–2 summarizes the field sample collection information for each of the locations. Sample analysis will be performed either at the on-site laboratory or a contract laboratory dependent on specific analyses required, laboratory capacity, turnaround time, and performance of the laboratory. The laboratories used for analytical testing have been audited to ensure that DOECAP or equivalent process requirements have been met as specified in the LM QAPP. These criteria include meeting the requirements for performance evaluation samples, pre-acceptance audits, performance audits, and an internal quality assurance program.

5.4.2.1 Sampling Procedures

Specific sampling procedures associated with surface water and treated effluent will be performed in accordance with directives established in the LM SAP and the LM QAPP.

Following are project-specific sampling considerations:

- Only recently deposited surface sediment shall be collected, typically from deposition locations such as areas with a slow flow rate (e.g., obstructions in the stream bed that allow sediment to be deposited).
- Samples shall be collected from the top two inches and consist of fine-grained material.
- Any non-sediment materials shall be discarded from the sample, any free water drained from the non-sediment material, and the non-sediment material placed in the sample container.

Table 5–2. Sediment Sampling Program Design and Analytical Requirements

Location *Expectation*	**Number of Locations**	**Sample Frequency**	**Constituent**[a]	**ASL**[b]	**Container**	**Holding Time**	**Preservative**
Great Miami River (G4) *Measure the impact of site effluent*	1	Annually	Uranium, Total	B	500 mL glass or plastic jar	6 months	None
Great Miami River background (G2) *Establish range of background concentration in Great Miami River*	1	Annually	Uranium, Total	B	500 mL glass or plastic jar	6 months	None

[a]Analytical Methods are from Procedure Manual of the Environmental Measurements Laboratory.
[b]A more conservative ASL may be required for laboratory data in order to meet required detection limits or in order to ensure data quality objectives.

The exact locations of the sediment sample points are approximate and may change based on where stream flow has deposited sufficient material for sampling. Sediment samples are collected and analyzed according to Table 5–2.

5.4.2.2 Quality Control Sampling Requirements

Quality control samples will be taken according to the frequency recommended in the LM SAP and LM QAPP. These samples will be collected and analyzed to evaluate the possibility that some controllable practice, such as decontamination, sampling, or analytical technique, may be responsible for introducing bias in the analytical results. One field duplicate will be collected from the G4 location in the Great Miami River.

5.4.2.3 Decontamination

Decontamination of sampling equipment will be performed between sample locations to prevent the introduction of contaminants or cross contamination into the sampling process. The decontamination is identified in the LM QAPP and more specifically outlined in the LM SAP.

5.4.2.4 Waste Disposition

Contact wastes that are generated by the field technicians during field sampling activities are collected and placed in a clean trash receptacle.

5.4.3 Change Control

Changes to the medium-specific plan will be at the discretion of the project team leader. Prior to implementation of field changes, the project team leader or designee shall be informed of the proposed changes and circumstances substantiating the changes. Any changes to the medium-specific plan must have written approval by the project team leader or designee, Quality Assurance representative, and the Field Manager prior to implementation. If a Variance/Field Change Notice is required, it will be completed in accordance with the LM QAPP. The Variance/Field Change Notice form shall be issued as controlled distribution to team members and will be included in the field data package to become part of the project record. During revisions to the IEMP, Variance/Field Change Notices will be incorporated to update the medium-specific plan.

5.4.4 Health and Safety Considerations

All involved personnel will receive adequate training to the health and safety requirements prior to implementation of the fieldwork required by this medium-specific plan. Safety meetings will be conducted prior to beginning fieldwork to address specific health and safety issues. Health and Safety requirements are also addressed in the Fernald Project Health and Safety Plan.

5.4.5 Data Management

Field documentation and analytical results will meet the IEMP data reporting and quality objectives, comply with the LM QAPP, the LM Standard Practice for Validation of Laboratory Data, and the LM SAP.

Data documentation and validation requirements for data collected for the IEMP fall into two categories depending upon whether the data are field- or laboratory-generated. Field data validation will consist of verifying compliance and appropriate documentation of field activities. Laboratory data validation will consist of verifying that data generated are in compliance with specified ASL B. Specific requirements for field data documentation and validation and laboratory data documentation and validation are in accordance with the LM QAPP, the Standard Practice for Validation of Laboratory Data, and the LM SAP. ASL B provides qualitative, semi-qualitative, and quantitative data with some quality assurance/quality control checks. The IEMP sediment data will undergo validation to ensure that analytical data are in compliance with the ASL B method criteria being requested and in order to meet data quality objectives.

Data will be entered into a controlled database using a double key or other verification method to ensure accuracy. The hard-copy data will be managed in the project file in accordance with LM record keeping requirements and DOE Orders.

5.4.6 Quality Assurance

Assessments of work processes may be conducted to verify quality of performance, and may include audits, surveillances, inspections, tests, data verification, field validation, and peer reviews. Assessments shall include performance-based evaluation of compliance-to-technical and procedural requirements, and corrective action effectiveness necessary to prevent defects in data quality. Assessment documentation shall verify that work was conducted in accordance with IEMP, LM SAP, and LM QAPP requirements.

5.5 IEMP Sediment Monitoring Data Evaluation and Reporting

This section provides the methods to be used in analyzing the data generated by the IEMP sediment sampling program. It summarizes the data evaluation process and actions associated with various monitoring results. The planned reporting structure for IEMP-generated sediment data to be reported in the annual site environmental reports is provided.

5.5.1 Data Evaluation

Data resulting from the IEMP sediment program will be evaluated to meet the program expectations identified in Section 5.3.1. Based on these expectations, the following questions will be answered through the sediment data evaluation process, as indicated:

- Have changes in the residual contaminant concentrations occurred in sediments found in the Great Miami River as a result of runoff and treated effluent from the site?

  Data evaluation will consist of comparison to historical data, background levels, and FRLs. This evaluation will identify long-term trends of targeted radiological constituents in sediment to determine if the potential exists for an FRL exceedance in the future. As indicated in Figure 5–2, results of the data interpretation will be communicated to project personnel to implement appropriate actions, as necessary.

- Should the sediment program be refined in scope?

  Data evaluation to determine if the IEMP sediment program should be revised will be based on the comparison to historic ranges and the sediment FRLs. Data evaluation to address any remaining expectations identified in Section 5.3.1 is encompassed in the data evaluation techniques described above.

- Are community concerns being met through the IEMP sediment program?

  The IEMP fulfills the need of the Fernald community by preparing sediment environmental results in annual site environmental reports. DOE makes these reports available to the public at the Public Environmental Information Center.

- Are the program and reporting requirements of DOE Order 450.1 being met?

  DOE Order 450.1 requires that DOE implement and report results from the environmental protection program for the Fernald site. The sediment monitoring program is one component of the site-wide IEMP monitoring program. This IEMP and annual site environmental reports fulfill the requirements of this DOE Order.

5.5.2 Reporting

The IEMP sediment program data will be reported on the DOE-LM website and in the annual site environmental report. Data on the DOE-LM website will be in the format of searchable data sets and/or downloadable data files. The DOE-LM website will be updated when sediment data become available. Additional information on IEMP data reporting is provided in Section 7.0.

The annual site environmental report will supplement the DOE-LM website by providing a summary and assessment of the data results, and identifying notable results and/or events related to those data.

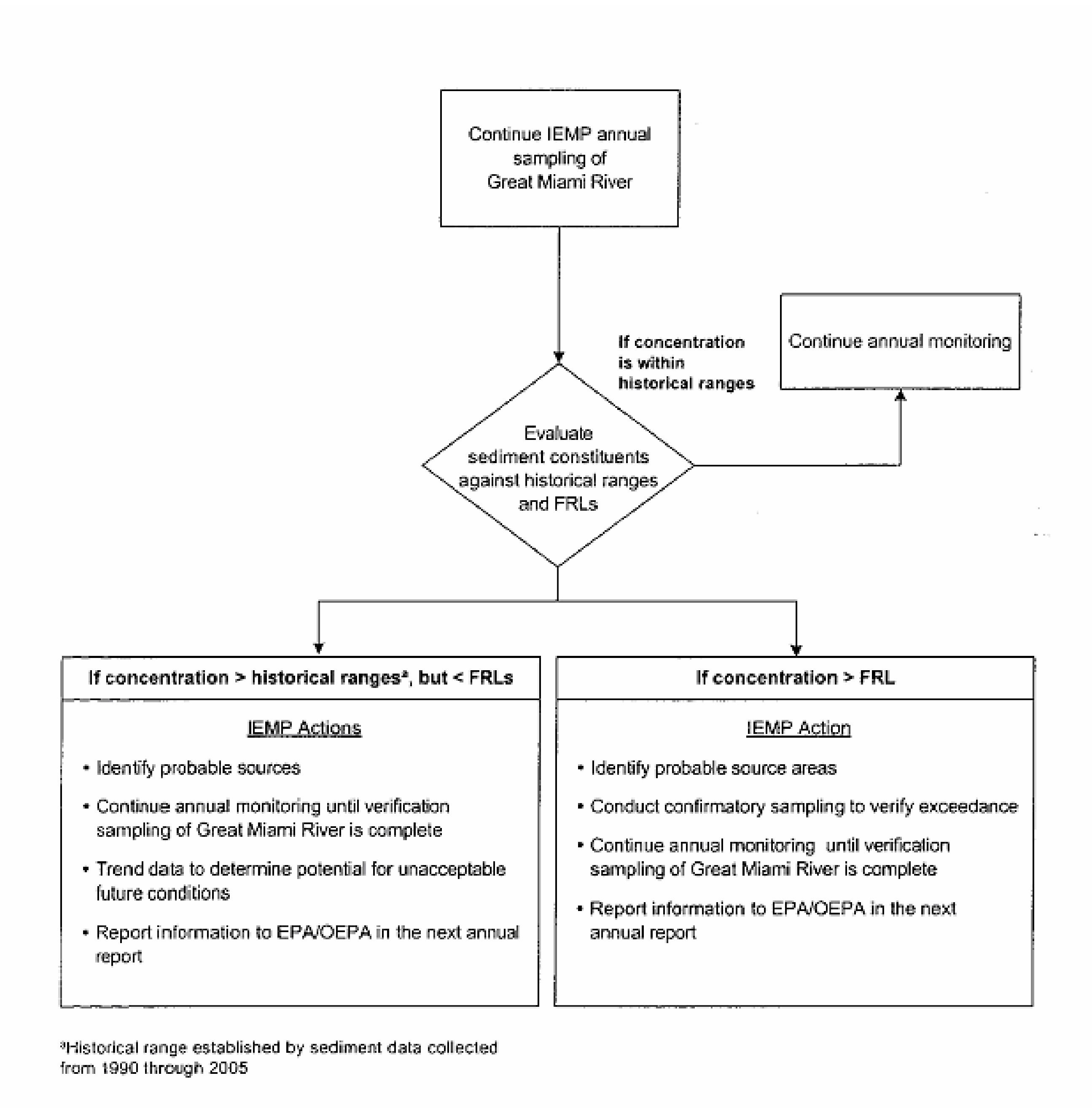

Figure 5–2. IEMP Sediment Data Evaluation and Associated Actions

The IEMP annual site environmental report will be issued each June and will include the following:

- An annual summary of data from the IEMP sediment monitoring program (Great Miami River sample locations); graphical presentation of data trends over time for the Great Miami River locations
- Statistical summary (i.e., minimum, maximum, and mean) by constituent for Great Miami River locations

If necessary, sediment results will be presented prior to the submittal of annual site environmental report to the EPA and OEPA if significant changes in sediment contaminant concentrations are evident.

Because the IEMP is a living document, a schedule of annual reviews and 5-year revisions has been instituted. The annual review cycle provides the mechanism for identifying and initiating any sediment program modifications (i.e., changes in constituents, locations, or frequencies) that are necessary. Any program modifications that may be warranted prior to the annual review will be communicated to EPA and OEPA.

6.0 Air Monitoring Program

Section 6.0 discusses the monitoring strategy for assessing the air pathway. The strategy identifies the activities conducted to satisfy requirements for particulate, radon, and direct radiation monitoring. A medium-specific plan for conducting site-wide and off-property air monitoring activities is provided, along with a plan for reporting air-related activities.

6.1 Integration Objectives for the Air Monitoring Program

The IEMP air-monitoring-program objectives for 2008 are consistent with program objectives in previous IEMP revisions. The objectives involve physically monitoring the air pathway to demonstrate compliance with 40 CFR 61 Subpart H and the requirements of DOE Orders. These assessments will be integrated with the assessments of the other media sampled under the IEMP and provided to regulatory agencies in reports according to the reporting schedule established in Section 6.5 and summarized for all media in Section 7.0.

The IEMP site boundary air monitoring program will continue through the year. Then the removal of air monitors (particulate, radon, and direct radiation) will be discussed through the conference calls and/or correspondence with the EPA and OEPA on a case-by-case basis.

A reporting plan is provided in Section 6.5 to combine the results of the air assessment program and the NESHAP dose assessments into a single reporting mechanism to facilitate regulatory agency review of the site-wide remediation activities and associated emission controls. Appendix C outlines the Fernald Preserve's plan for demonstrating NESHAP Subpart H compliance and producing a required dose assessment.

6.2 Analysis of Regulatory Drivers, DOE Policies, and Other Fernald Preserve Site-Specific Agreements

This section identifies the pertinent regulatory requirements, including ARARs and to-be-considered requirements, for the scope and design of the air monitoring program. These requirements will be used to confirm that the program satisfies the regulatory obligations for monitoring that have been activated by the RODs and will achieve the intentions of other pertinent criteria (such as DOE Orders and the Fernald Preserve existing agreements) that have a bearing on the scope of air monitoring.

6.2.1 Approach

The analysis of the additional regulatory drivers and policies for air assessments was conducted by identifying the suite of ARARs and to-be-considered requirements in the approved CERCLA RODs and legal agreements that contain specific air monitoring requirements. This subset was further divided to identify those monitoring requirements with site-wide implications (and, therefore, fall under the scope of the IEMP).

6.2.2 Results

The following regulatory drivers govern the technical scope and reporting requirements for the IEMP's site-wide air monitoring program:

- DOE Order 450.1, *Environmental Protection Program*, which requires DOE facilities that use, generate, release, or manage significant pollutants or hazardous materials to develop and implement an environmental monitoring plan. Each DOE site's environmental monitoring plan must contain the design criteria and rationale for the routine effluent monitoring and environmental surveillance activities of the facility. The IEMP strategy is responsive to the changing site mission and complies with DOE Orders.
- DOE Order 5400.5, *Radiation Protection of the Public and Environment*, which establishes radiological dose limits and guidelines for the protection of the public and environment. Under this requirement, the exposure to members of the public associated with activities from DOE facilities from all pathways must not exceed, in 1 year, an effective dose equivalent of 100 mrem. For radiological dose due to airborne emissions only, the DOE Order requires compliance with the 40 CFR 61 Subpart H limit of an effective dose equivalent of 10 mrem/year to a member of the public. Demonstration of compliance with this standard is to be based on an air monitoring approach. The DOE Order also provides guidelines for radionuclide concentrations in air (known as Derived Concentration Guides) and radon concentration limits for interim storage of sources during remediation.
- Proposed 10 CFR 834, *DOE Facilities Radiation Protection of the Public and Environment*, which is similar in intent to DOE Order 5400.5. However, differences include the deletion of the 100-pCi/L limit and 30-pCi/L annual limit, lowering the fenceline limit to 0.5 pCi/L above background, changes to facility and facility boundary definitions, and clarification of the definition of "point of compliance."
- NESHAP 40 CFR 61 Subpart H, which provides national emissions standards for radionuclides other than radon. Per this requirement, emissions of radionuclides (excluding radon) to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent in excess of 10 mrem/year. Demonstration of compliance with this standard is to be based on an air monitoring approach.
- Federal Facility Agreement (FFA), *Control and Abatement of Radon-222 Emissions*, signed November 19, 1991, which ensures that DOE takes all necessary actions to control and abate radon-222 emissions at the Fernald Preserve.
- DOE Order 435.1, *Environmental Monitoring*, which requires low-level radioactive waste disposal facilities to perform environmental monitoring. This requirement applies to the OSDF because it is the only disposal facility at the Fernald Preserve. Instead of a separate monitoring plan for the OSDF, the air monitoring program for the OSDF will be integrated and incorporated into the IEMP's air monitoring program.
- Per the CERCLA Remedial Design Work Plan for remedial actions at OU5, monitoring will be conducted as required following the completion of cleanup to assess the continued protectiveness of the remedial actions. The IEMP will specify the type and frequency of environmental monitoring activities to be conducted, following the cessation of remedial operations as appropriate.

Upon evaluating the IEMP ARARs in consideration of protection of human health and the environment, the 10-mrem/year dose limit was determined to be the most stringent emission limit. Therefore, the 10-mrem/year NESHAP standard provides a reasonable benchmark for ensuring compliance with all other air standards (excluding radon) and ensuring an adequate level of protectiveness.

Other regulatory drivers have air monitoring implications of an emissions control nature that fall outside the scope of the IEMP. These requirements pertain to the monitoring of fugitive area emission controls and the monitoring of point source emissions, and if necessary, they will be considered during post-closure. The drivers for fugitive dust include:

- Ohio General Provisions on Air Pollution Control, Air Pollution Nuisances Prohibited, OAC 3745-15-07 and Ohio Revised Code (ORC) 3704.01-05, which prohibits the emission or escape into the open air of smoke, ashes, dust, dirt, grime, acids, fumes, gases, vapors, and odors in such amounts that may cause a public nuisance.
- Ohio Emissions of Particulate Matter, Restriction of Emission of Fugitive Dust, OAC 3745-17-08, which provides for the restriction of emission of fugitive dust by the use of control measures. Such control measures include, for example, water or dust suppression chemicals for control of fugitive dust from demolition of buildings or on dirt or gravel roads, the use of hoods or fans to enclose and control fugitive dust, and the use of canvas or other coverings for stockpiles.

The regulatory drivers for point and other sources include:

- NESHAP 40 CFR 61 Subpart H, which provides national emissions standards for radionuclides other than radon. This regulation also requires emission measurements at point sources with a potential to discharge radionuclides into the air in quantities that could cause an effective dose equivalent in excess of 1 percent of the standard (10 mrem/year).

Table 6–1 lists all of the requirements above and includes each of the air assessment regulatory requirements to be conducted under the IEMP and the associated assessment designed to comply with each requirement. Sections 6.5 and 7.0 outline the plan for complying with the reporting requirements invoked by the IEMP regulatory drivers.

Table 6–1. Fernald Preserve Air Monitoring Program Regulatory Drivers and Responsibilities

	DRIVER	ACTION
IEMP	DOE Order 450.1, Environmental Protection Program Environmental Monitoring Plan for all media	The IEMP describes effluent and surveillance monitoring as required by DOE Order 450.1.
IEMP	DOE Order 5400.5, Proposed 10 CFR 834 Radiation Protection of the Public and Environment	The IEMP describes on-site and off-site monitoring for radon and other radionuclides, and monitoring to determine annual dose from the air pathway.
IEMP	NESHAP 40 CFR 61, H Emission Standards for Radionuclides (excluding radon)	The IEMP includes an assessment of the annual dose to the public from the air pathway.
IEMP	Federal Facility Agreement Control and Abatement of Radon-222 Emissions	The IEMP includes radon monitoring.
IEMP	DOE Order 435.1, Radioactive Waste Management	The IEMP boundary monitoring includes air monitoring at locations adjacent to the OSDF.

6.3 Program Expectations and Design Considerations

6.3.1 Program Expectations

The IEMP air assessment program has been designed to collect data sufficient to meet the following expectations for 2008:

- Provide a program that will provide a continual assessment to determine if the air monitoring results are as low as reasonably achievable (ALARA).
- Provide assessment data sufficient to demonstrate compliance with 40 CFR 61 Subpart H requirements ensuring that no member of the public receives an annual effective dose equivalent in excess of 10 mrem.
- Provide data sufficient to determine compliance with the radon concentration limits of DOE Order 5400.5 and 10 CFR 834.
- Provide measurements of direct radiation sufficient to support the annual dose assessment calculations required by DOE Order 5400.5 accounting for exposure pathways.
- Provide a program that promotes the continued confidence of the public and is responsive to concerns raised by stakeholders regarding forthcoming remediation activities.

6.3.2 Design Considerations

The air assessment program comprises three distinct components:

- Radiological air particulate monitoring.
- Radon monitoring.
- Direct radiation monitoring.

Each component of the site-wide air assessment program is designed to address a unique aspect of air pathway monitoring and, as such, reflects distinct sampling methodologies and analytical procedures. The following sections and Appendix C provide a detailed discussion on the design of the IEMP air assessment program.

6.3.2.1 Radiological Air Particulate Monitoring Design Summary

The radiological air particulate monitoring program for 2008 is designed to fulfill the following primary program expectations:

- Provide a continual assessment and early-warning feedback to determine if air monitoring results meet the health protective NESHAP standard of 10 mrem.
- Provide sufficient monitoring data to demonstrate compliance with 40 CFR 61 Subpart H requirements ensuring that no member of the public receives an annual effective dose equivalent greater than 10 mrem.

To meet these expectations during 2008, the program design is based on taking direct measurements of radionuclide concentrations in the environment at the site boundary and a background location (Figure 6–1). Five high-volume air monitoring stations have been chosen, based on the location of the potential off-site receptors and in consideration of the 16 primary

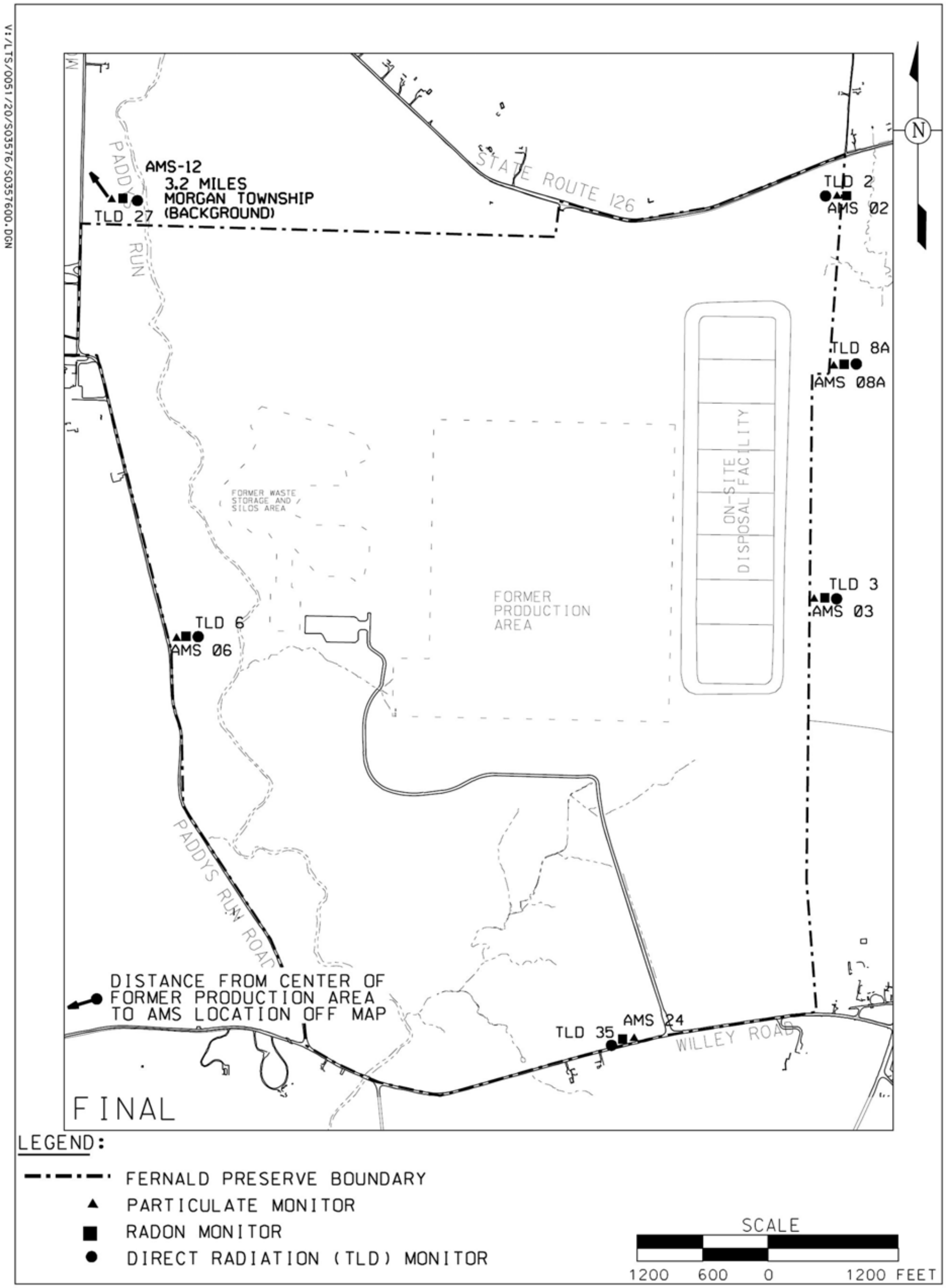

Figure 6–1. Post-Closure Air Monitoring Locations for 2008

wind rose sectors (Figure 6–2). In addition, there is one background monitor (AMS-12). The criteria found in the *Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring* (40 CFR 58, Appendix E) and provided by EPA were considered when selecting these locations.

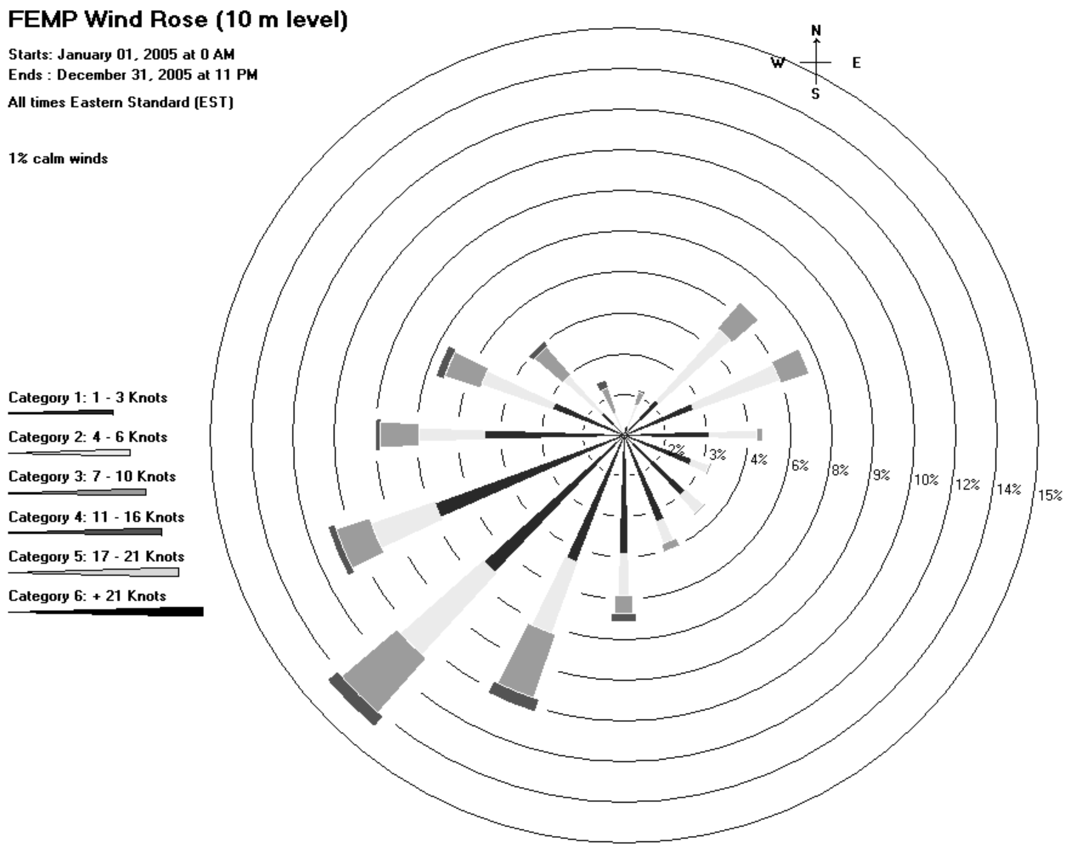

Figure 6–2. Average Fernald Site Wind Rose Data, 2000–2005

The sampling and analysis plan for the air particulate monitoring program is designed to meet the following two fundamental criteria:

- Provide routine analysis that supports a timely evaluation.
- Account for contributors to dose as defined in 40 CFR 61.93(b)(5)(ii).

Based on these criteria, the sampling and analysis frequency for the radiological air particulate monitoring program for 2008 consists of the following:

- Monthly Uranium and Total Particulate Samples:

  Filters will be exchanged monthly at all air monitoring stations and will be analyzed for total uranium and total particulate. Monitoring frequency is monthly based on the lack of major sources. Section 6.5 presents the data evaluation process.

- Quarterly Composite Samples:

  A portion of each monthly sample will be used to form a quarterly composite sample for each air monitoring station. The quarterly composite samples will be analyzed at an off-site laboratory for the expected major contributors to dose, including uranium-238, uranium-235/236, uranium-234, thorium-232, thorium-230, thorium-228, and radium-226. The results of the quarterly composite data will be used to track compliance against the NESHAP Subpart H standard. The data will also be incorporated into the ongoing evaluation of emission controls.

The key isotopes selected for quarterly analysis represent the major contributors to dose, based on the following considerations:

- Radionuclides that were stored in large quantities at the Fernald Preserve and were handled or processed during the remediation effort.
- Radionuclides that were the major contributors to dose, based on environmental and stack-filter measurements.

Additional technical information supporting the sampling and analysis plan presented here is provided in Appendix C. Table 6–2 presents a summary of the analytical and sampling information provided below.

6.3.2.2 Radon Monitoring Design Summary

The monitoring design is influenced by the radon concentration limits established in DOE Order 5400.5 and Proposed 10 CFR 835, and satisfies FFA–mandated monitoring requirements. Continuous environmental radon monitors collect data representing the short-term fluctuations in radon concentrations. These monitors are placed at five locations at the Fernald Preserve boundary and at one off-site background location. The monitoring locations reflect DOE guidance for siting environmental samplers. Figure 6–1 depicts the locations of continuous alpha scintillation monitors.

Data from the monitors are used to assess compliance with the following limits outlined in DOE Order 5400.5 and Proposed 10 CFR 834:

- 100 pCi/L at any given location and any given time.
- Annual average concentration of 30 pCi/L (above background) over the facility.
- Annual average concentration of 0.5 pCi/L (above background) at and beyond the Fernald Preserve boundary (Proposed 10 CFR 834).

Site boundary monitors are collocated with the high-volume air particulate samplers and fulfill the Proposed 10 CFR 834 monitoring and reporting requirements.

The instrument background is the combination of the laboratory-determined count rate for a specific electronic instrument (also known as electronic noise), and any counts from trace radioactive decay products and impurities found in the scintillation material of the continuous radon monitor as measured in a radon-free environment. Instrument background is subtracted from the measurement data prior to comparing data from site boundary and on-site monitors to data from the background monitor. Instrument background corrected data will be presented in IEMP summary reports.

Table 6–2. Sampling and Analytical Summary for Radiological Air Particulate Samples

Constituent	Sample Matrix	Sample Frequency	ASL[a]	Detection Level	Container
Total Uranium	Air	Monthly	B	2-µg/filter	20 cm × 25 cm polypropylene 0.3-µm filter
Total Particulate	Air	Monthly	A	NA[b]	20 cm × 25 cm polypropylene 0.3 µm filter
Uranium-234 Uranium-235/236 Uranium-238 Thorium-228 Thorium-230 Thorium-232 Radium-226	Air	Quarterly composite	E	9×10^{-5} pCi/m3 9×10^{-5} pCi/m3 9×10^{-5} pCi/m3 7×10^{-6} pCi/m3 7×10^{-6} pCi/m3 7×10^{-6} pCi/m3 2×10^{-4} pCi/m3	NA[b]

[a]The ASL may become more conservative if it is necessary to meet detection limits or data quality objectives.
[b]NA = not applicable

Table 6–3 summarizes the sampling and analysis plan for the radon monitoring program.

Table 6–3. Sampling Analytical Summary for Continuous Radon Detectors

Constituent	Sample Matrix	Sample Frequency	ASL	Holding Time	Preservative	Detection Level	Detection Method
Radon-222	Air	Continuous/24 hours	A	NA[a]	NA[a]	0.05 to 0.15 pCi/L	Alpha Scintillation

[a]NA = not applicable

6.3.2.3 Direct Radiation Monitoring Design Summary

The direct radiation monitoring component of the IEMP program is designed to collect measurements of environmental radiation levels. This is accomplished using five environmental thermoluminescent dosimeters (TLDs) collocated with the air particulate monitors at the site boundary and one background location off site. Figure 6–1 identifies the TLD monitoring locations.

The TLDs provide a mechanism to measure and track ambient radiation levels that used to be at the Fernald Preserve boundary from gamma-emitting radioactive materials (primarily radium-226, thorium-232, and their decay products).

Three individual TLDs are placed at each location in order to assess the precision of the data. The TLDs are placed 1 meter above the ground and exchanged quarterly in accordance with industry standards and DOE guidance. The TLDs are processed at the DOE Laboratory Accreditation Program–approved laboratory.

Data from the TLDs are used to assess the direct radiation component of the air pathway dose calculation (refer to Appendix C). Table 6–4 summarizes the sampling and analysis plan for the direct radiation monitoring program.

Table 6–4. Analytical Summary for Direct Radiation (TLD)

Analyte	Sample Matrix	Sample Frequency	ASL[a]	Holding Time	Preservative	Detection Level	Container
Gamma Radiation	TLD	Quarterly	B	NA[b]	NA[b]	5 mrem	NA[b]

[a]The ASL may become more conservative if it is necessary to meet detection limits or data quality objectives.
[b]NA = not applicable

6.3.2.4 Meteorological Monitoring Program Design Summary

Although not a distinct component of the existing site-wide air monitoring program, the meteorological monitoring program is designed to provide data on the atmospheric conditions that influence the dispersion and transport of contaminants in the air pathway. This data is available to assist in the evaluation and interpretation of air monitoring data.

Meteorological data are used in the evaluation and interpretation of radon and environmental data collected from air. Meteorological data is obtained from a local weather station through the National Weather Service, as necessary.

6.4 Medium-Specific Plan for Site-Wide Environmental Air Monitoring

This section serves as the medium-specific plan for implementation of the sampling, analytical, and data-management activities associated with the site-wide environmental air monitoring program. The program expectations and design presented in Section 6.3 were used as the framework for developing the monitoring approach presented in this section. The activities described herein were designed to provide environmental data of sufficient quality to meet the intended data use as described in the program design in Section 6.3.2. All sampling procedures and analytical protocols described or referenced in this medium-specific plan are consistent with the requirements of the LM QAPP and LM SAP.

The subsections of this medium-specific plan define the following:

- Program organization and associated responsibilities
- Sampling programs (radiological air particulate, radon, and direct radiation)
- Change control
- Health and safety
- Data management
- Project quality assurance

6.4.1 Project Organization

A multidiscipline project organization has been established and assigned responsibility to effectively implement and manage the project planning, sample collection and analysis, and data management activities directed in this medium-specific plan. The key positions and associated responsibilities required for successful implementation are described as follows.

The project team leader will have full responsibility and authority for the implementation of this medium-specific plan in compliance with all regulatory specifications and site-wide programmatic requirements. Integration and coordination of all medium-specific plan activities defined herein with other project groups are also key responsibilities. All changes to project activities must be approved by the project team leader or designee.

Health and safety are the responsibility of all individuals working on this project scope. Qualified health and safety personnel shall participate on the project team to provide radiation protection and industrial hygiene support and to assist in preparing and obtaining all applicable permits. In addition, safety personnel shall periodically review and update the project-specific health and safety documents and operating procedures, conduct pertinent safety briefings, and assist in the evaluation and resolution of all safety concerns.

Quality assurance personnel will participate on the project team as necessary to review project procedures and activities ensuring consistency with the requirements of the LM QAPP or other referenced standards and assist in evaluating and resolving all quality-related concerns.

6.4.2 Sampling Program

Sample analysis will be performed at off-site contract laboratories, depending on specific analyses required, laboratory capacity, turnaround time, and performance of the laboratory. The laboratories used for analytical testing meet DOECAP requirements as specified in LM QAPP. These criteria include meeting the requirements for performance evaluation samples, pre-acceptance audits, performance audits, and an internal quality assurance program.

6.4.2.1 Sampling Procedures

Specific sampling procedures associated with air monitoring will be performed in accordance with directives established in the LM SAP and the LM QAPP and the requirements of the *Environmental Regulatory Guide for Radiological Effluent Monitoring*.

<u>Air Particulate</u>
Table 6–5 provides the technical specifications for radiological air particulate monitoring using high-volume air monitoring equipment and filter media.

Table 6–5. Technical Specifications for Radiological Air Particulate Monitoring

Monitor Type	Flow Rate	Filter Type	Gauge/Meters	Indicator
High-volume continuous	45 cfm	Multi-ply polypropylene	Hours Flow-rate set point	Low-flow warning light

Sample collection is accomplished by using high-volume air monitoring stations that continuously collect samples of airborne particulates. Any changes in flow rate are accounted for by the automatic flow controller in the monitor and are documented on a flow chart recorder that continuously records flow data. Air monitoring equipment must meet the following criteria per DOE guidance and industry practice:

- Environmental air samplers shall be mounted in locked, all-weather stations with the sampler discharge positioned to prevent the recirculation of air.
- The air sampling system shall have a flow-rate meter, and the total air flow or total running time should be indicated.
- The air sampling rate should not vary by more than 10 percent of the monitor set point of 45 cfm for the collection of a given sample.
- Linear flow rate across air particulate filters should be maintained between 20 and 50 meters per minute (m/min).
- Air sampling systems shall be flow-calibrated, tested, and routinely inspected according to written procedures. Flow calibration shall be at least as often as recommended by the manufacturer.

The monitors are inspected and calibrated at least once a year according to manufacturer recommendations. All units placed in the field are tracked via a field-tracking log that tells when calibrations were last completed and the date of the next scheduled calibration. Boundary monitors are checked daily to ensure continuous operation.

Radon

Continuous environmental radon monitors are calibrated as a unit at least once per year (as specified per sampling procedures) with National Institute of Standards and Technology traceable sources. Monitors are tracked upon deployment in the field via an equipment-tracking log and field logbooks. The instrument background reading is also recorded for use in data evaluation and reporting. In addition, an equipment-maintenance/calibration logbook is used to track and schedule units requiring maintenance and calibrations.

Table 6–3 provides a sample and analytical summary of the radon monitoring program. The continuous environmental radon monitors used at the Fernald Preserve are passive devices, meaning radon diffuses into the continuous passive radon detector without the aid of a pump. Alpha particles generated by radioactive decay of the radon and its daughters interact with the inside surface of the detector, producing photons of light. The light photons interact with a photo-multiplier tube that generates electrical pulses. The number of pulses in a given time period is proportional to a radon concentration. The monitors are set to collect measurements of 1-hour duration.

Direct Radiation (TLDs)

Table 6–4 provides a sample and analytical summary for the direct radiation monitoring program. Sample collection is accomplished using Panasonic UD-814 dosimeters or equivalent dosimeters. Environmental TLDs must meet the following criteria as per DOE guidance:

- Environmental TLDs shall be mounted at one meter above ground.

- The frequency of exchange should be based on predicted exposure rates from site operations.
- The exposure rate should be long enough (typically one calendar quarter) to produce a readily detectable dose.
- Annealing, calibration, readout, storage, and exposure periods used should be consistent with the American National Standard Institute (ANSI) standard recommendations.

All TLDs placed in the field are tracked via a field-tracking log that tells when and where dosimeters were deployed as well as scheduled collection dates.

6.4.2.2 Quality Control Sampling Requirements

Quality control samples will be taken according to the frequency recommended in the LM QAPP and LM SAP. These samples will be collected and analyzed in order to evaluate the possibility that some controllable practice, such as a sampling or analytical practice, may be responsible for introducing bias in the project's analytical results. The following quality assurance samples will be collected under this sampling program:

<u>Air Particulate Samples</u>

- One blank sample will be submitted for analysis with each set of quarterly composite samples.
- The laboratory is also required to perform analyses on method blanks, matrix spikes, and laboratory control samples as required by the LMQAPP for the corresponding ASL and analytical method. For the quarterly composite samples analyzed under ASL E, a method blank, duplicate, matrix spike, and laboratory control sample will be analyzed for each batch of samples.

<u>Radon Monitoring</u>
Quality control practices for the continuous environmental radon monitors will be maintained per established maintenance and calibration schedules outlined in the applicable operating procedures. Quality control data will be recorded on process control charts and only instruments demonstrating acceptable performance will be used in the field to collect data. At a minimum, the continuous environmental radon monitors will be source checked monthly. Acceptable performance is defined as generating source check results that fall within three standard deviations of the mean expected efficiency in accordance with typical industry standard practices. If the source check results for an instrument fall outside of the three-standard-deviation control limit, then that instrument will not be used again until it is examined, repaired, and calibrated, if necessary.

<u>Direct Radiation (TLDs)</u>
Quality control samples will be collected and analyzed in order to evaluate the possibility that some controllable practice, such as sampling or analytical practice, may be responsible for introducing bias in the project's analytical results. Quarterly data from the three TLDs at each location must agree within 15 percent or will be considered suspect and invalid data.

6.4.2.3 Decontamination

Decontamination of sampling equipment will be performed between sample locations to prevent the introduction of contaminants or cross contamination into the sampling process. The decontamination is identified in the LM QAPP and more specifically outlined in the LM SAP.

6.4.2.4 Waste Disposition

Contact wastes that are generated by the field technicians during field sampling activities are collected, maintained, and dispositioned as necessary, depending upon the location of waste generation.

6.4.3 Change Control

Changes to the medium-specific plan will be at the discretion of the project team leader. Prior to implementation of field changes, the project team leader or designee shall be informed of the proposed changes and circumstances substantiating the changes. Any changes to the medium-specific plan must have written approval by the project team leader or designee, quality assurance representative, and the field manager prior to implementation. If a Variance/Field Change Notice is required, then it will be completed according to the LM QAPP. The Variance/Field Change Notice form shall be issued as controlled distribution to team members and will be included in the field data package to become part of the project record.

6.4.4 Health and Safety Considerations

The Fernald Preserve's health and safety personnel are responsible for the development and implementation of health and safety requirements for this medium-specific plan. Hazards (physical, radiological, chemical, and biological) typically encountered by personnel when performing the specified fieldwork will be addressed during team briefings. Health and safety requirements are also addressed in the Fernald Preserve Project Safety Plan. Fernald Preserve specific requirements are identified in this plan.

All involved personnel will receive adequate training to the health and safety requirements prior to implementation of the fieldwork required by this medium-specific plan. Safety meetings will be conducted prior to beginning fieldwork to address specific health and safety issues. All Fernald employees and subcontractor personnel who will be performing fieldwork required by this medium-specific plan are required to have completed applicable training.

For areas that are subject to more restrictive radiological controls where the potential for exposure is greater, radiation work permits are necessary and will be obtained prior to the fieldwork being performed in those areas. A radiological control technician will be assigned to each field crew performing any activities in an area requiring a radiation work permit.

6.4.5 Data Management

Field documentation and analytical results will meet the IEMP data reporting and quality objectives, comply with the LM QAPP, the *LM Standard Practice for Validation of Laboratory Data*, and the LM SAP.

Data documentation and validation requirements for data collected in 2008 for the IEMP fall into two categories, depending upon whether the data are field- or laboratory-generated. Field data validation will consist of verifying medium-specific plan compliance and appropriate documentation of field activities. Laboratory data validation will consist of verifying that data generated are in compliance with medium-specific plan ASLs. Specific requirements for field data documentation and validation and laboratory data documentation and validation are in accordance with the LM QAPP, the *Standard Practice for Validation of Laboratory Data*, and the LM SAP.

There are five analytical levels (ASL A through ASL E) defined for use at the Fernald Preserve. For 2006, field data documentation will be at ASL A and laboratory data documentation will be at ASL B. For some air programs, a more conservative ASL is required for laboratory data to meet regulatory commitments in order to meet required detection limits, or to ensure data quality objectives are met. The specific air monitoring ASL requirements are detailed in the sampling programs subsections above and in Appendix C.

At a minimum, 10 percent of the IEMP data will undergo validation to ensure that analytical data are in compliance with the ASL method criteria being requested and in order to meet data quality objectives. The percentage of data validated could increase in order to meet data quality objectives.

Data will be entered into a controlled database using a double key or verification method to ensure accuracy. The hard-copy data will be managed in the project file in accordance with LM record keeping requirements and DOE Orders.

6.4.6 Quality Assurance

Assessments of work processes shall be conducted to verify quality of performance, and may include audits, surveillances, inspections, tests, data verification, field validation, and peer reviews. Assessments shall include performance-based evaluation of compliance to technical and procedural requirements and corrective action effectiveness necessary to prevent defects in data quality. Assessments may be conducted at any point in the life of the project. Assessment documentation shall verify that work was conducted in accordance with IEMP, LM SAP, and LM QAPP requirements.

Recommended semiannual quality assurance assessments or surveillances shall be performed on tasks specified in the medium-specific plan. These assessments may be in the form of independent assessments or self-assessments, with at least one independent assessment conducted annually. Independent assessments are the responsibility of quality assurance personnel. The project team leader and quality assurance personnel will coordinate assessment activities and comply with the LM QAPP. The project or quality assurance personnel shall have "stop work" authority if significant adverse effects to quality conditions are identified or work conditions are unsafe.

6.5 IEMP Air Monitoring Data Evaluation and Reporting

This section provides the methods to be used in analyzing the data generated by the IEMP air assessment program in 2008. It summarizes the data evaluation process and actions associated with various monitoring results. The planned reporting structure for IEMP-generated air monitoring data in the annual site environmental report is also provided.

6.5.1 Data Evaluation

Data resulting from the IEMP air monitoring program will be evaluated to meet the program expectations identified in Section 6.3.1. Based on these expectations, the following questions will be answered for all air monitoring programs:

- Are the program and reporting requirements of DOE Order 450.1 being met?

  DOE Order 450.1 requires that DOE implement and report on an environmental protection program for the Fernald Preserve. The air assessment program is one component of the site-wide IEMP monitoring program. This IEMP and the annual site environmental report fulfill the requirements of this DOE Order.

- Are the program emissions ALARA?

  The programs (air particulate monitoring, radon monitoring, and direct radiation monitoring) are designed to provide continual assessments of air monitoring results with respect to ALARA.

- Are community concerns being met through the air monitoring IEMP program?

  The IEMP fulfills the needs of the Fernald community by presenting air monitoring results in the annual site environmental report.

Specific air program (i.e., radiological air particulate, radon, and direct radiation) evaluation process questions are identified in the following subsection. Figure 6–3 shows the overall air decision making processes with respect to the IEMP.

<u>Radiological Air Particulate Data Evaluation</u>
Based on the expectations in Section 6.3.1, the following questions will be answered for the radiological air particulate program:

- Are the collective air monitoring results in line with ALARA?
- Do the air- inhalation dose calculations indicate potential air emissions are below the NESHAP public dose limit?

  Basic statistics (such as minimum, maximum, and mean) will be routinely generated per sample location as the data are received from the laboratory. The data generated from individual sampling events will be trended by sample location over time via statistical methods when sufficient data have been generated. Do the results of quarterly composite radionuclide concentrations indicate that the dose limit of NESHAP Subpart H may be exceeded?

- Are modifications or adjustments in program focus necessary?

  The quarterly composite results will be compared to the NESHAP Appendix E, Table 2 values. If the comparison indicates a contaminant other than uranium, radium, or thorium is contributing the largest percentage of dose, then modifications to the IEMP air monitoring and analytical schedule may be proposed in order to better monitor the major contributors to inhalation dose.

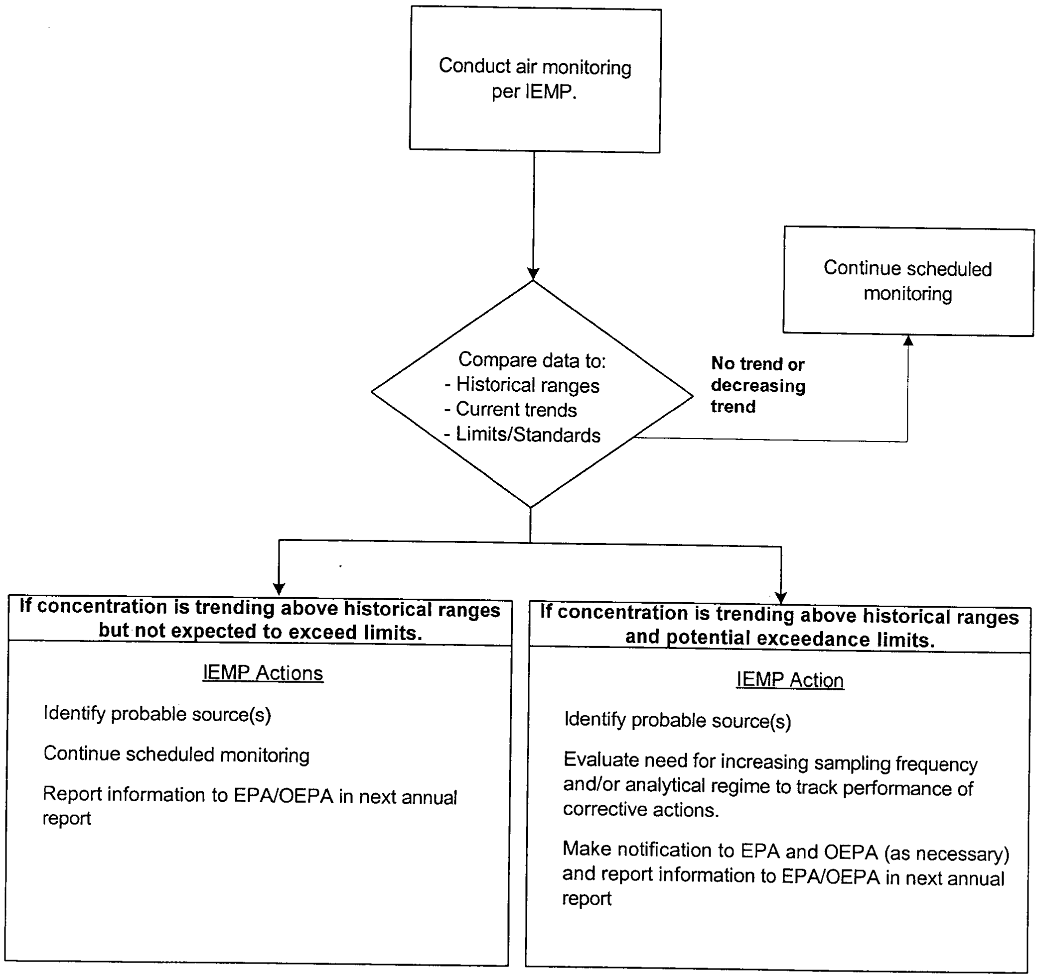

Figure 6–3. IEMP Air Data Evaluation and Associated Actions

<u>Radon Data Evaluation</u>

Data resulting from the radon monitoring program will be evaluated with respect to the program expectations identified in Section 6.3.1 and radon monitoring design summary in Section 6.3.2.2. Based on these expectations, the following questions will be answered through the radon data evaluation processes indicated by the text following each of the questions:

- Are radon concentrations below the limits set in DOE Order 5400.5 and 10 CFR 834?

  Data from the alpha scintillation continuous radon monitoring locations will be compared to the annual limits (0.5 pCi/L above background at the site fenceline and 30 pCi/L site-wide), and short-term (100 pCi/L) limits of DOE Order 5400.5. The data generated from individual sampling events will be trended by sample location over time via statistical methods (when sufficient data have been generated).

  If historical data are available from or near a particular IEMP sample location, then the IEMP-generated trends will be evaluated with respect to the historical trends in order to assess whether current conditions are similar to the past, increasing, or decreasing.

Direct Radiation Monitoring Data Evaluation

Data resulting from the direct radiation monitoring program will be evaluated with respect to the program expectations identified in Section 6.3.1 and direct radiation monitoring design summary in Section 6.3.2.3. Based on these expectations, the following questions will be answered through the direct radiation data evaluation processes indicated by the text following the question:

- Do direct radiation levels indicate a significant increase that could contribute to an exceedance of the 100-mrem/year, all-pathway dose limit from DOE Order 5400.5?

  The data generated from individual TLD locations will be trended over time. Historical TLD monitoring data will be used to assess whether current trends are similar to the past, increasing, or decreasing.

6.5.2 Reporting

The IEMP air monitoring program will meet the reporting requirements for the NESHAP Subpart H, 10 CFR 834, and the FFA compliance, as follows:

- The NESHAP Subpart H report has been incorporated into the annual site environmental report.
- The quarterly FFA reporting is being fulfilled via the DOE-LM website.
- Monthly trending of the annual limit of 0.5 pCi/L above background.

IEMP air program data will be reported on the DOE-LM website in the form of electronic files and in the annual site environmental report. Additional information on IEMP data reporting is provided in Section 7.0.

Data on the DOE-LM website is in the form of searchable data sets and/or downloadable data files. This site will be updated every four weeks, as data become available.

The annual site environmental report will be issued each June for the previous year. This comprehensive report will discuss a year of IEMP data previously reported on the DOE-LM website. The air monitoring portion of the annual site environmental report will consist of the following:

- An annual summary of data from the IEMP air monitoring program.
- Constituent concentrations for each sample location.
- Statistical analysis summary for each constituent, as warranted by data evaluation.
- Status of regulatory compliance with NESHAP Subpart H.
- Summary of FFA radon information.
- Information that indicates the exceedance of an ARAR at an on-site location.
- Information that is relevant to explaining significant changes in the data from the IEMP air monitoring network.

Air data will continue to be provided to EPA and OEPA electronically via the DOE-LM website as the data become available.

End of current text

7.0 Program Reporting

7.1 Introduction

This section summarizes how the reporting discussions in Sections 3.0 through 6.0 are integrated and provides an overview of the entire environmental data reporting strategy.

7.2 Program Design

As discussed throughout this document, the IEMP combines environmental monitoring requirements that have been activated by the ARARs and to-be-considered requirements (contained in the Fernald Preserve's CERCLA remedy decision documents), as well as other ongoing monitoring programs required by other regulatory requirements. In combining these elements, the IEMP establishes a site-wide environmental monitoring program that continues to meet the effluent and surveillance monitoring requirements of DOE Orders 450.1 and 5400.5. IEMP medium-specific monitoring programs were developed through a systematic evaluation of existing monitoring scopes, technical considerations, pertinent regulatory drivers, and critical Fernald site stakeholder concerns.

The IEMP is designed to provide accurate, accessible, and manageable environmental monitoring information to support the following:

- Continued compliance with the monitoring and reporting requirements contained in DOE Orders 450.1, 231.1, and 5400.5.
- Fulfilling additional site-wide monitoring and reporting requirements activated by the CERCLA ARARs for each ROD, including determining when environmental restoration activities are complete and cleanup standards have been achieved.
- Monitoring the performance of the Great Miami Aquifer groundwater remedy, including determination of when restoration activities are complete.
- Providing a consolidated reporting mechanism for environmental data.

7.2.1 IEMP Monitoring Summary

The IEMP monitoring scope for groundwater, surface water, sediment, and air has been described in detail in Sections 3.0 through 6.0. The summary that follows is intended to provide the basis for each medium's monitoring program. Evaluation of each program will form the basis for any IEMP program modifications in the future.

Groundwater: The groundwater monitoring program for the Great Miami Aquifer provides for monitoring water quality and water levels in monitoring wells distributed over the aquifer restoration area, along the Fernald site's downgradient property boundary, and at a few private well locations. These wells provide a monitoring network to track the progress of the aquifer restoration and to monitor groundwater quality in the area of the OSDF. The analytical requirements for this monitoring program are based on the FRLs documented in the ROD for Remedial Actions at OU5.

Surface Water: The surface water and treated effluent monitoring program is designed to assess the impacts on surface water. The non-radiological discharge monitoring and reporting related to the NPDES Permit have been incorporated into the IEMP.

Sediment: The IEMP sediment sampling program determines whether substantial changes to current residual contaminant conditions occur in the sediment along the Great Miami River. Sediment sampling will continue at the Great Miami River sample points for uranium to verify that no adverse impacts have occurred to sediment.

Air: The air monitoring program consists of three distinct sampling elements: airborne particulate monitoring stations, radon monitoring locations, and direct radiation monitoring locations. Each element has five monitoring locations at the Fernald Preserve boundary, and one off-site background location.

7.2.2 Program Review and Revision

As noted in the executive summary, the IEMP has been integrated into this revision of the LMICP. The IEMP is no longer a stand-alone document with its own review and revision cycle. It will be reviewed and revised each October. Revisions will identify any program modifications that are necessary as a result of progressive findings of the IEMP, and any changes to existing regulatory agreements or requirements applicable to site-wide monitoring.

In addition to the IEMP-sponsored review and revision obligations, an independent review and assessment mechanism exists through the Cost Recovery Grant reached between OEPA and DOE. The Cost Recovery Grant provides a way for OEPA to conduct an independent review of DOE environmental monitoring programs. OEPA's role, as defined in the Cost Recovery Grant, is to independently verify the adequacy and effectiveness of DOE's environmental monitoring programs through program review and independent data collection. Results of the OEPA review are summarized in an annual report that will be considered during the IEMP's annual review process. Modifications to the scope or focus of the IEMP, as a result of OEPA's activities, will be incorporated as necessary via the annual LMICP review process.

7.3 Reporting

As stated in Section 1.0, a primary objective of the IEMP is to successfully integrate the numerous routine environmental reporting requirements under a single comprehensive framework. The IEMP centralizes, streamlines, and focuses site-wide environmental monitoring and associated reporting under a single controlling document.

7.3.1 Regulatory Drivers for Reporting Monitoring Data

An analysis of regulatory drivers and policies was conducted by examining ARARs within each OU's ROD, Fernald site compliance agreements, and DOE Orders applicable to monitoring each medium. These regulatory drivers are identified in Sections 3.0 through 6.0 of the IEMP and were evaluated for reporting requirements. The following reporting drivers are in the IEMP reporting strategy:

- DOE Orders 450.1/231.1, *Environmental Protection Program Requirements/Environment, Safety and Health Reporting Manual*, which requires DOE facilities to submit annual site environmental reports that summarize the environmental monitoring data results.

- The September 7, 2000, *OEPA Director's Findings and Orders* (OEPA 2000), which requires continuation of the groundwater monitoring program as specified in this IEMP to meet RCRA/Ohio hazardous waste regulations for groundwater monitoring.
- The current NPDES Permit for the Fernald site, which requires monthly reports to demonstrate compliance with provisions in the NPDES Permit.
- The 1986 FFCA, which requires, per an agreement made with the EPA and OEPA in January 1996, submittal of quarterly data reports. Note that this requirement is being fulfilled through the posting of data to the DOE-LM website as the data becomes available.
- NESHAP 40 CFR 61, Subpart H, which requires submittal of an annual NESHAP report to demonstrate compliance with emission standards for radionuclides other than radon.
- FFA, *Control and Abatement of Radon-222 Emissions*, signed November 19, 1991, which requires, per an agreement made with EPA and OEPA in January 1996, submittal of the continuous air monitoring data in selected on-site areas in a quarterly progress report. Note that this requirement is being fulfilled through the posting of data to the DOE-LM website as the data becomes available.

7.3.2 IEMP Reporting

The IEMP reporting frequency will be annual with a continued emphasis on timely data reporting in the form of electronic files (i.e., the DOE-LM website). The annual site environmental report will continue to be submitted by June 1 to provide a comprehensive evaluation of IEMP data for both the regulatory agencies and the public, and electronic data will be made available to the regulatory agencies as soon as data have been reviewed.

<u>DOE-LM Website</u>
The DOE-LM website (http://www.lm.doe.gov/land/sites/oh/fernald/fernald.htm) allows the regulatory agencies access to Fernald data in a timely manner. The data are available after analysis, analytical validation, entry into SEEPro, and review by environmental media personnel. These data are provided in downloadable files; in some cases, user-defined queries for specific data sets are available. The use of the DOE-LM website for reporting IEMP data provides the agencies with access to IEMP data sooner than through the annual reports. In addition to the environmental media addressed in the IEMP, water quality and water accumulation rate data from the OSDF are included on the DOE-LM website.

<u>Annual Site Environmental Reports</u>
The annual site environmental report will continue to be submitted to EPA and OEPA on June 1 of each year. It will continue to document the technical monitoring approach, to summarize the data for each environmental medium, and to summarize CERCLA, RCRA, and waste management activities. The report will also include water quality and water accumulation rate data from the OSDF monitoring program. The summary report serves the needs of both the regulatory agencies and the public. The accompanying detailed appendices compile the information reported on the DOE-LM website and are intended for a more technical audience including the regulatory agencies.

Table 7–1 identifies the media that are being reported under the IEMP and the associated reporting schedule. Any program modifications that may be warranted prior to the annual review will be communicated to EPA and OEPA.

Table 7–1. IEMP Reporting Schedule for 2008

	2008											
	First Quarter			Second Quarter			Third Quarter			Fourth Quarter		
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
GROUNDWATER/OSDF[a]	∗	∗	∗	∗	∗	∗ ●	∗	∗	∗	∗	∗	∗
SURFACE WATER[b]	∗	∗	∗	∗	∗	∗ ●	∗	∗	∗	∗	∗	∗
NPDES PERMIT COMPLIANCE	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
SEDIMENT[c]						●					∗	
AIR[d]				∗		●	∗			∗		

∗= DOE-LM website Data Reporting
●=Annual Reporting
♦=Monthly Reporting

[a]Encompasses aquifer restoration operational assessment, aquifer conditions, and OSDF groundwater monitoring.
[b]Encompasses NPDES and IEMP characterization monitoring.
[c]Sediment data will be collected annually at the Great Miami River.
[d]Encompasses all air monitoring programs including FFA and NESHAP Subpart H.

8.0 References

APHA (American Public Health Association), 1989. *Standard Methods for the Examination of Water and Wastewater*, 17th edition, Washington, DC

DOE (U.S. Department of Energy), 1991. *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, DOE/EH 0173T, Assistant Secretary for Environment, Safety and Health, Washington, DC, January.

DOE (U.S. Department of Energy), 1992. *Work Plan for the South Contaminated Plume Removal Action*, Fernald Environmental Management Project, Cincinnati, Ohio.

DOE (U.S. Department of Energy), 1993. *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, Change 2, U.S. Department of Energy, Washington, DC, January 7.

DOE (U.S. Department of Energy), 1995a. *Feasibility Study Report for Operable Unit 5*, Final, Fernald Environmental Management Project, Cincinnati, Ohio, June.

DOE (U.S. Department of Energy), 1995b. *Final Operable Unit 5 Proposed Plan*, 6865 U 007 405.3, Final, Fernald Environmental Management Project, Cincinnati, Ohio, May 1.

DOE (U.S. Department of Energy), 1995c. *Remedial Investigation Report for Operable Unit 5*, Final, Fernald Environmental Management Project, Cincinnati, Ohio, March.

DOE (U.S. Department of Energy), 1995d. *Fernald Site Environmental Monitoring Plan*, PL 1002, Revision 2, Fernald Environmental Management Project, Cincinnati, Ohio.

DOE (U.S. Department of Energy), 1996a. *Record of Decision for Remedial Actions at Operable Unit 5*, 7478 U 007 501.4, Final, Fluor Fernald, Cincinnati, Ohio, January.

DOE (U.S. Department of Energy), 1996b. *Remedial Design Work Plan for Remedial Actions at Operable Unit 5*, Final, Fernald Environmental Management Project, Cincinnati, Ohio.

DOE (U.S. Department of Energy), 1996c. "Phase VII Removal Actions and Reporting Requirements Under the Fernald Environmental Management Project Legal Agreements," letter #DOE 0395 96 from Johnny Reising of DOE to James A. Saric of EPA and Tom Schneider of OEPA, Fernald Environmental Management Project, Cincinnati, Ohio, January 16.

DOE (U.S. Department of Energy), 1997a. *Baseline Remedial Strategy Report, Remedial Design for Aquifer Restoration (Task 1)*, Fernald Environmental Management Project, Cincinnati, Ohio.

DOE (U.S. Department of Energy), 1997b. *Procedures Manual of the Environmental Measurements Laboratory*, Fernald Environmental Management Project, Cincinnati, Ohio.

DOE (U.S. Department of Energy), 1997c. *Restoration Area Verification and Sampling Program*, Project Specific Plan, Final, Fernald Environmental Management Project, Cincinnati, Ohio.

DOE (U.S. Department of Energy), 1997d. *Integrated Environmental Monitoring Plan*, 2505 WP 0022, Revision 0, Final, Fernald Environmental Management Project, Cincinnati, Ohio.

DOE (U.S. Department of Energy), 2000a. *Conceptual Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas*, Final, Fernald Environmental Management Project, Cincinnati, Ohio.

DOE (U.S. Department of Energy), 2000b. *The Great Miami Aquifer VAM3D Flow Model Recalibration Report*, Fernald Environmental Management Project, Cincinnati, Ohio.

DOE (U.S. Department of Energy), 2001a. *Radioactive Waste Management Manual*, DOE Manual 435.1, Change 1, Washington, DC, June 19.

DOE (U.S. Department of Energy), 2001b. *Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas*, Revision A, Draft Final, Fernald Environmental Management Project, Cincinnati, Ohio, April.

DOE (U.S. Department of Energy), 2002. *Design for Remediation of the Great Miami Aquifer, South Field (Phase II) Module*, Revision A, Draft Final, Fernald Environmental Management Project, Cincinnati, Ohio, May.

DOE (U.S. Department of Energy), 2003a. *Remedial Design Work Plan and DOE order 450.1*, Fernald Closure Project, Cincinnati, Ohio.

DOE (U.S. Department of Energy), 2003b, *Comprehensive Groundwater Strategy Report*, Revision A, Draft, Fernald Closure Project, Cincinnati, Ohio.

DOE (U.S. Department of Energy), 2003c. *Site-Wide CERCLA Quality Assurance Project Plan*, FD 1000, Revision 3, Final, Fluor Fernald, Cincinnati, Ohio, November 14.

DOE (U.S. Department of Energy), 2004. *Groundwater Remedy Evaluation and Field Verification Plan*, Fernald Closure Project, Cincinnati, Ohio, June.

DOE (U.S. Department of Energy), 2005a. *National Emissions Standards for Hazardous Air Pollutants,* Subpart H, 60200-RP-0009, Revision 0, Final, Fernald Closure Project, Cincinnati, Ohio, June.

DOE (U.S. Department of Energy), 2005b. *Waste Storage Area (Phase II) Design Report*, 52424 RP 0004, Revision A, Draft Final, Fernald Closure Project, Cincinnati, Ohio, June.

DOE (U.S. Department of Energy), 2005c. *Addendum to the Waste Storage Area (Phase II) Design Report*, 52424 RP 0004, Revision A, Draft Final, Fernald Closure Project, Cincinnati, Ohio, June.

DOE (U.S. Department of Energy), 2005d. *Storm Sewer Outfall Ditch*, Revision 0, Final, Fernald Closure Project, Cincinnati, Ohio, June.

DOE (U.S. Department of Energy), 2005e. *Fernald, Ohio, Site Project Safety Plan*, DOE-LM/GJ1068-2005, Revision 0, S.M. Stoller Corporation, Grand Junction, Colorado, December.

DOE (U.S. Department of Energy), 2005f. *2004 Site Environmental Report*, 51350 RP 0024, Fernald Closure Project, Cincinnati, Ohio, June.

DOE (U.S. Department of Energy), 2006a. Comprehensive Management and Institutional Controls Plan, 20013-PL-0001, Revision 1, Final, Fluor Fernald, Cincinnati, Ohio, June.

DOE (U.S. Department of Energy), 2006b. *Fernald Groundwater Certification Plan*, 51900-PL-0002, Revision 1, Final, Fluor Fernald, Cincinnati, Ohio, April.

DOE (U.S. Department of Energy), 2006c. *Legacy Management CERCLA Sites Quality Assurance Project Plan*, DOE-LM/GJ1189-2006, S.M. Stoller Corporation, Grand Junction, Colorado, May.

DOE (U.S. Department of Energy), 2006d. *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Site*, DOE-LM/GJ1197-2006, Revision 0, S.M. Stoller Corporation, Grand Junction, Colorado, May.

DOE (U.S. Department of Energy), 2006e. *Legacy Management Fernald Operating Procedures*, Revision 0, S.M. Stoller Corporation, Grand Junction, Colorado.

EPA (U.S. Environmental Protection Agency), 1983. *Methods for Chemical Analysis of Water and Wastes*, EPA/600/4-79-020, Washington, DC, March.

EPA (U.S. Environmental Protection Agency), 1991. *Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*, EPA/600/489034, Office of Research and Development, Washington, DC, March.

EPA (U.S. Environmental Protection Agency), 1992. *General Methods for Remedial Operation Performance Evaluations*, EPA/600/R 92/002, Robert S. Kerr Environmental Research Laboratory, Ada, Oklahoma, January.

EPA (U.S. Environmental Protection Agency), 1998. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, EW 846, Revision 5, Washington, DC, April.

Fluor Fernald Inc., 2004. "Discharge Changes — National Pollutant Discharge Elimination System Permit Number 1IO00004*GD Fernald Closure Project," letter #C:SP:2004 0036 from Dennis J. Carr of Fluor Fernald Inc. to Thomas A. Winston of OEPA, Fernald Closure Project, Cincinnati, Ohio, June 3.

HydroGeologic Inc., 1998. *Development and Verification of VAM3DF, a Numerical Flow and Transport Modeling Code*, Final, Herndon, Virginia.

HydroGeologic Inc., 2000. *Integration of Data Fusion Modeling (DFM) with VAM3DF Contaminant Transport Code*, Final, Herndon, Virginia.

OEPA (Ohio Environmental Protection Agency), 1993. “Ohio EPA Director’s Final, Findings and Orders, in the Matter of: U.S. Department of Energy, Fernald Environmental Management Project,” P.O. Box 398704, Cincinnati, Ohio 45239, Columbus, Ohio, September 10.

OEPA (Ohio Environmental Protection Agency), 2000. “Ohio EPA Director’s Final Findings and Orders, in the Matter of: U.S. Department of Energy, Fernald Environmental Management Project,” P.O. Box 398704, Cincinnati, Ohio 45239, Columbus, Ohio, September 7.

Appendix A

The Revised Groundwater Monitoring Approach

Contents

Figures

Tables

End of current text

1.0 Introduction

This appendix provides detailed justification for the groundwater sampling program presented in Section 3.0. The groundwater sampling program was initiated in August of 1977 and remained relatively unchanged until January 1, 2003. Based on the results and findings derived from the groundwater data that was collected under the Integrated Environmental Monitoring Plan (IEMP) from 1997 through 2001, a revised groundwater monitoring program was initiated in January 2003. This program was initiated due to the general absence of final remediation level (FRL) exceedances during the first five years of sampling under the IEMP program.

The revised sampling program uses a representative monitoring strategy to successfully track remedy progress and ultimately determine the completion of groundwater restoration, while satisfying regulatory commitments and administrative requirements.

Conservative constituent selection criteria were developed to define the sampling program. These criteria included categorizing the 50 FRL constituents according to their fate and transport mobility characteristics and identifying the location-specific distribution of each constituent's FRL exceedances in the aquifer. The initial basis for each constituent's distribution was determined with sampling results obtained from 1988 through 1995 under the IEMP, Revision 0 (DOE 1997). This sampling was conducted in support of the Operable Unit 5 Remedial Investigation/Feasibility Study reports (DOE 1995a and b) and subsequent pre-IEMP programs. The constituent FRL exceedance distributions were updated with IEMP data through 1999 in the IEMP, Revision 2 (DOE 2001a) and have been updated with each subsequent IEMP revision. The distribution of the constituent-specific FRL exceedances was evaluated zone-by-zone to identify the geographic distribution of the exceedances. The five established zones include areas both inside and outside the WSA (Phase II) remediation footprint and are comprised of the following general areas:

- Zone 0 – The area outside of Zones 1 through 4
- Zone 1 – Waste storage area
- Zone 2 – South Field
- Zone 3 – Northeastern portion of the site
- Zone 4 – Southern portion of the South Plume

Figure A–1 shows the areas covered by each zone along with the Waste Storage Area (Phase II) remediation footprint. The following sections provide a summary of the IEMP groundwater data results and findings, the groundwater monitoring approach, and general.

2.0 IEMP Groundwater Results and Findings

The summary results and findings of the IEMP groundwater data from1997 through 2006 are provided in two tables: Table A–1 presents overall information for the 50 constituents with FRLs; Table A–2 provides specific information for the constituents that have FRL exceedances. Figures A–2 through A–17 provide constituent-specific locations of wells that have exceedances with respect to the site and the aquifer zones.

IEMP Groundwater Data for the 50 FRL Constituents

Table A–1 summarizes groundwater sampling results since the inception of IEMP program and contains the following information:

- Column 1 lists the 50 constituents for which FRLs were established in the Operable Unit 5 Record of Decision.
- Column 2 lists the respective FRL concentration for each of the constituents.
- Column 3 identifies the basis for each FRL constituent (i.e., risk, applicable or relevant and appropriate requirement [ARAR], background, or detection limit) as defined in the Operable Unit 5 Feasibility Study Report.
- Column 4 documents the number of samples that have been analyzed for each constituent since the start of IEMP sampling.
- Column 5 notes the number of samples that have had a concentration greater than the FRL for each constituent.
- Column 6 notes the percent of the samples for each constituent that have had a concentration greater than the FRL.
- Column 7 identifies the zones where FRL exceedances have been observed and the number of wells in each zone that had exceedances.
- Column 8 shows the concentration range for each constituent that had FRL exceedances.

As shown in the table, 35 of the constituents have not had any FRL exceedances while 15 of the 50 FRL constituents have had at least one FRL exceedance. Of the 15 constituents having FRL exceedances, the following observations are noted:

- As expected, uranium is by far the predominant constituent of concern with over 25 percent of the sample results exceeding the FRL.
- Two additional constituents have greater than 5 percent of their sample results above the FRL (zinc and manganese).
- Five constituents (nickel, lead, molybdenum, technetium-99, and nitrate) have between 1 and 3 percent of their sample results above their respective FRL.
- Six constituents (boron, carbon disulfide, trichloroethene, antimony, arsenic and fluoride) have more than one FRL exceedance, but have less than 1 percent of their sample results exceeding their respective FRL.
- One constituent, vanadium, has a one-time exceedance in 1998 in one well.

IEMP Groundwater Data for the FRL Exceedances

Figures A–2 through A–17 show the geographic distribution for the 15 constituents with FRL exceedances. These maps show that:

- Uranium is the constituent with the greatest number exceedances in the greatest number of wells. These exceedances have occurred in Zones 1 through 4.
- Both zinc and manganese have exceedances in Zones 0 through 4 in 40 and 32 wells, respectively. The remaining 12 constituents have exceedances in fewer than 12 wells, with vanadium having an exceedance in only one well.

- Five constituents have exceedances in only one zone. They are boron – Zone 2 (South Field); molybdenum – Zone 1 (waste storage area); mercury – Zone 3 (former Plant 6 area); vanadium –Zone 0, and technetium-99 – Zone 1 (waste storage area).
- Five constituents (boron, molybdenum, nitrate/nitrite, uranium, and trichloroethene) have exceedances solely inside the Waste Storage Area (Phase II) remediation footprint; nine constituents have exceedances both inside and outside the footprint; and vanadium has an exceedance in one well outside the footprint.

With the exception of uranium, these constituents had exceedances in a limited number of wells, and the spatial distribution of these exceedances indicates many of these constituents are not associated with a plume.

Table A–2 identifies the frequency of FRL exceedances for each well and constituent that had an exceedance since the inception of the IEMP. This table contains the following information:

- Column 1 lists the 15 non-uranium constituents which have had FRL exceedances since the inception of the IEMP.
- Column 2 lists the wells that have FRL exceedances for each of the constituents.
- Column 3 identifies the corresponding zone for each well with an exceedance.
- Column 4 identifies the frequency with which each constituent is monitored at the well of interest.
- Columns 5 through 9 show for each year and quarter (August 1997 through December 2005) the distribution of each constituent/well FRL exceedance. An "X" indicates when an exceedance occurred.

From review of Table A–2, the following observations can be made for the non-uranium constituents with more than one FRL exceedance:

- Since 2001 there were fewer FRL exceedances than for the previous years.
- The reduction in the number of exceedances starting in 2001 is particularly striking for metals.
- Most constituents do not have concentrations that are consistently above their respective FRLs. The constituents with consistent exceedances include: boron (Zone 2), manganese (Zones 0, 1, and 3), molybdenum (Zone 1), nickel (Zone 3), nitrate/nitrite (Zone 1), technetium-99 (Zone 1), trichloroethene (Zone 1), and zinc (Zones 0 and 2).

  Note: Consistent exceedances are considered to be any constituent/well combination that has at least four consecutive exceedances. Sampling frequencies, which are identified in Table A–2, have been factored into this evaluation.

<u>Conclusions</u>
The information presented in the referenced tables and figures identifies the general absence of FRL exceedances for many of the FRL constituents since the inception of IEMP sampling. This absence of FRL exceedances resulted in the 2003 revision to the IEMP groundwater sampling program, allowing for focus on the constituents that continue to exceed their respective FRLs. In revising the sampling program, the modeling approach was taken to ensure the continued achievement of the groundwater sampling program objectives. Constituents with FRL exceedances will continue to be monitored in order to track the progress of the remedy and to

determine whether it is necessary to change the design of the aquifer remedy. Additionally, continued monitoring of constituents that have not had FRL exceedances will ensure that remediation of the source operable units is not adversely impacting aquifer conditions. Monitoring requirements will also continue to satisfy regulatory commitments and administrative requirements.

3.0 Monitoring Approach

This section provides the details associated with the monitoring approach:

- Section 3.1 − Monitoring FRL constituents with exceedances.
- Section 3.2 − Monitoring FRL constituents without exceedances.
- Section 3.3 − Monitoring to satisfy regulatory commitments and administrative requirements.

Each section provides the constituents to be monitored along with sampling frequencies and locations.

3.1 Monitoring FRL Constituents with Exceedances

The current monitoring approach was implemented in January 2003. Prior to January 2003, constituents with exceedances had been monitored as frequently as quarterly or at least annually. Slow groundwater flow rates and the resultant slow plume migration rates justify going to a semiannual sampling schedule. Specifically, on average the uranium contamination only travels 33–83 feet per year. Therefore, monitoring semiannually should be sufficient to track the groundwater remedy.

To successfully address the monitoring of constituents with FRL exceedances, two criteria were considered: geographic location (i.e., zones) of exceedances; and consistency and recentness of exceedances.

For the 15 constituents shown to have exceedances, the following monitoring is recommended:

1. Uranium, which is the primary constituent of concern and has the greatest number of wells with exceedances, will be monitored sitewide. Monitoring locations are presented in Figure A–18. Review of Figure A–18 indicates that the spatial distribution and density of monitoring wells will be sufficient to ensure that remedy performance is successfully monitored.

2. Constituents that have FRL exceedances in multiple zones (i.e., antimony, arsenic, fluoride, lead, manganese, nickel, and zinc) will be monitored as follows:

    - At a minimum, all constituents will be monitored at locations that include existing property boundary/on-site disposal facility wells along the eastern perimeter of the site and those wells along the eastern/southern boundary of the South Plume. Area C in Figure A–19 shows the configuration of this monitoring network, which lies in Zones 0, 2, 3, and 4, and outside of the 10-year, time-of-travel remediation footprint. Monitoring at these locations will ensure that the progress of the remedy is being tracked and will help determine whether to change the design of the aquifer remedy.

Note: Carbon disulfide and nitrate/nitrite are considered to have legitimate exceedances in Zone 1 only. They are discussed below (item #3).

- In addition to being monitored in Zones 0, 2, 3, and 4, constituents that have exceedances in multiple zones were evaluated with respect to Zone 1 to determine if monitoring should be conducted to address consistent/recent exceedances in this area. Monitoring will be addressed in this zone, in addition to the monitoring at the property/plume boundary, to ensure that the constituents exhibiting consistent/recent exceedances are being monitored near potential sources. From review of Table A–2, it appears that only manganese in Zone 1 has recent and consistent exceedances. Therefore, it will be monitored in this zone at wells that have exceedances. Refer to Area A in Figure A–19 for the locations to be monitored in Zone 1. In addition to manganese, nickel had an exceedance in 2002. Nickel will also be monitored in Zone 1.

3. Constituents that have FRL exceedances in only one zone will be monitored only in that zone. In Zone 1, carbon disulfide, molybdenum, nitrate/nitrite, technetium-99, and trichloroethene will be monitored; boron will be monitored in Zone 2 (South Field). Specific monitoring locations will be based on the wells that have exceedances. Refer to Areas A and B in Figure A–19 for the monitoring locations for these constituents in Zones 1 and 2.

   Note: Carbon disulfide has exceedances primarily in Zone 1. The two wells with exceedances outside Zone 1 were property boundary Wells 2432 and 3069. These wells were sampled quarterly and exceedances were minimally above the FRL (6 µg/L with respect to the 5.5 µg/L FRL). For Well 2432, there have been no additional exceedances since the occurrence during first quarter 1999. With regard to the one exceedance that occurred during fourth quarter 2001 for Well 3069, a duplicate result during the sampling event was below the FRL (refer to Figure A–5). No additional exceedances for carbon disulfide have occurred at Well 3069 since 2001.

4. Nitrate/nitrite has exceedances primarily in Zone 1. One well, 2017, which is located in Zone 2, had a one-time exceedance in 1998.

5. Vanadium had a one-time exceedance in 1998 during IEMP quarterly sampling at one well, 2426 (refer to Table A–2). This constituent will be monitored less frequently than semiannually due to the lack of exceedances. Monitoring for this constituent is addressed in Section A.3.2.

Summary

Table A–3 consolidates the information above pertaining to non-uranium constituents that have FRL exceedances and identifies whether these constituents have single or multiple zone exceedances. The table also identifies the constituents that have consistent/recent exceedances and the monitoring program under which these constituents will be monitored.

The monitoring program ensures that all FRL exceedances are monitored at sufficient frequencies (semiannually) and locations, that the remedy progress is being tracked, that monitoring near potential sources is occurring, and that data are being collected to determine whether the remedy needs to be modified. Specifically, uranium will be monitored sitewide to track the overall remedy and determine when restoration is complete. Monitoring for non-uranium constituents both inside and outside the Waste Storage Area (Phase II) remediation footprint is addressed by sampling constituents with the following criteria:

- Those with exceedances occurring in only one zone. This sampling addresses the objectives of monitoring near potential sources and tracking of remedy progress.
- Those with exceedances occurring in multiple zones at the property/plume boundary, which encompasses Zones 0, 2, 3, and 4. This sampling tracks remedy progress and indicates whether a change to the remedy is necessary. Additionally, sampling for constituents with multiple-zone exceedances that prove to be consistent/recent in Zone 1 will be performed near potential sources to track the remedy progress.

3.2 Monitoring FRL Constituents without Exceedances

As presented in the Fernald Groundwater Certification Plan, (DOE 2006) non-uranium FRL constituents with no exceedances since the inception of the IEMP will no longer be monitored every five years. They will be monitored for again during the first quarter of the third year of Stage III “Certification/Attainment Monitoring” as part of a streamlined confirmation strategy. All FRL constituents were monitored in 2001 at approximately 90 locations, with the exception of the two dioxins and chromium VI, which were sampled at 19 and five locations respectively. The lack of exceedances identified in this extensive 2001 sampling effort, along with the Fernald-area groundwater flow rates, justify the streamlined confirmation strategy presented in the Fernald Groundwater Certification Plan.

The following are some specific monitoring requirements for dioxins (i.e., octachlorodibenzo-p-dioxin and 2,3,7,8-tetrachlorodibenzo-p-dioxin) and chromium VI:

- Streamlined confirmation for dioxin will only take place in the waste storage area. In 2001, 19 locations (2008, 2009, 2010, 2016, 2032, 2027, 2045, 2046, 2048, 2385, 2648, 2649, 2821, 3009, 3032, 3045, 3046, 3385, and 3821) were monitored (refer to DOE letter #DOE-0642-01, "Request to Reduce the Number of IEMP Groundwater Monitoring Wells to be Sampled for Dioxin," dated June 13, 2001 [DOE 2001b]). Of the 19 locations that were sampled for dioxins in 2001, none had detected dioxin results.
- Even though re-injection was discontinued in late 2004, streamlined confirmation for chromium VI will still take place in Monitoring Wells 22301, 22302, and 22303. These wells are located within 25 feet of the once active re-injection wells.

3.3 Monitoring to Satisfy Regulatory Commitments and Administrative Requirements

The monitoring protocol outlined in Sections 3.1 and 3.2 will satisfy regulatory requirements currently identified in Section 3, Table 3–1. The following will be continued:

- Routine monitoring to ensure remedy performance and to evaluate impacts of remediation activities to the Great Miami Aquifer.
- Monitoring private wells to evaluates the contribution of the groundwater pathway to the annual dose to the public.
- Routine sampling of the South Plume wellfield in terms of the total volume extracted and the amount of uranium removed.

With respect to administrative requirements, monitoring for Paddys Run Road Site constituents will continue. With respect to constituents and locations, no change will be made to the current Paddys Run Road Site sampling program (refer to the shaded part of Area C in Figure A–19 for monitoring locations). Monitoring will be conducted semiannually concurrently with the property/plume boundary sampling activity. Sampling for Paddys Run Road Site plume constituents (i.e., phosphorous, arsenic, potassium, sodium, benzene, ethyl benzene, isopropyl benzene, toluene, and total xylene) will continue in order to document the influence, or lack thereof, that remedial groundwater pumping is having on the Paddys Run Road Site plume.

4.0 Conclusions

The sampling approach is considered conservative because constituents that had FRL exceedances during sampling under the IEMP will be monitored semiannually in areas of concern. Additionally, those constituents that have not exceeded their FRL will be included in a streamlined confirmation as part of the Fernald Groundwater Certification Process. The sampling activities will still ensure that the groundwater sampling program objectives of satisfying regulatory commitments, developing and using representative monitoring constituent lists to successfully track remedy progress, and ultimately determining when groundwater restoration activities are complete will continue to be met.

5.0 References

DOE (U.S. Department of Energy), 1995a. *Feasibility Study Report for Operable Unit 5*, Final, Fernald Environmental Management Project, Cincinnati, Ohio, June.

DOE (U.S. Department of Energy), 1995b. *Remedial Investigation Report for Operable Unit 5*, Final, Fernald Environmental Management Project, Cincinnati, Ohio.

DOE (U.S. Department of Energy), 1997. *Integrated Environmental Monitoring Plan*, 2505-WP-0022, Revision 0, Final, Fernald Environmental Management Project, Cincinnati, Ohio.

DOE (U.S. Department of Energy), 2001a. *Integrated Environmental Monitoring Plan,* 2505-WP-0022, Revision 2, Final, Fluor Fernald, Cincinnati, Ohio, January.

DOE (U.S. Department of Energy), 2001b. "Request to Reduce the Number of IEMP Groundwater Monitoring Wells to be Sampled for Dioxin," letter #DOE-0642-01, Fluor Fernald, Cincinnati, Ohio, June 13.

DOE (U.S. Department of Energy), 2003. *Integrated Environmental Monitoring Plan*, 2505-WP-0022, Revision 3, Final, Fluor Fernald, Cincinnati, Ohio, January.

DOE (U.S. Department of Energy), 2005. *Integrated Environmental Monitoring Plan*, 2505-WP-0022, Revision 4, Final, Fluor Fernald, Cincinnati, Ohio, January.

DOE (U.S. Department of Energy), 2006. *Fernald Groundwater Certification Plan*, 51900-PL-0002, Revision 1, Final, Fluor Fernald, Cincinnati, Ohio, April

Table A–1. Groundwater FRL Exceedances Based on Samples and Locations Since IEMP Inception (from August 1997 through 2006)

(1) Constituent	(2) Groundwater FRL[a]	(3) Basis for FRL[b]	(4) No. of Samples[c]	(5) No. of Samples >FRL[c,d]	(6) Percent of Samples >FRL	(7) Zones with FRL Exceedances (No. of Wells with Exceedances in each Aquifer Zone)[c,d,e]	(8) Range above FRL[c,d,e]
Uranium, Total	30 µg/L	A	4538	1155	25.45%	1(19) 2(38) 3(3) 4(16)	30.13 J/1240 NV
Zinc	0.021 mg/L	B	1267	81	6.39%	0(10) 1(5) 2(14) 3(5) 4(2)	0.0212 NV/13.6 -
Manganese	0.90 mg/L	B	1479	96	6.49%	0(5) 1(6) 2(10) 3(5) 4(4)	0.916 -/105 J
Nickel	0.10 mg/L	A	1301	20	1.54%	0(1) 1(1) 2(7) 3(1)	0.101 -/1.54 -
Technetium-99	94 pCi/L	R*	1532	35	2.28%	1(3)	101.08 -/1352.266 J
Nitrate[f]	11 mg/L	B	1923	38	1.98%	1(5) 2(1)[g]	11.4 -/331 NV
Lead	0.015 mg/L	A	1276	13	1.09%	0(2) 1(2) 2(4) 3(2)	0.0157 -/0.201 -
Arsenic	0.050 mg/L	A	1494	14	0.94%	0(1) 1(1) 2(1) 4(4)	0.051 -/0.125 -
Molybdenum	0.10 mg/L	A	835	13	1.56%	1(1)	0.207 -/0.69 -
Boron	0.33 mg/L	R	2065	15	0.73%	2(2)	0.331 -/1.16 -
Antimony	0.0060 mg/L	A	1277	9	0.70%	0(4) 1(1) 2(2)4(1)	0.00601 -/0.0196 J
Trichloroethene	0.0050 mg/L	A	1392	13	0.93%	1(2)	0.0207 -/0.120 -
Carbon disulfide	0.0055 mg/L	A	1023	6	0.59%	0(1)[h] 1(3) 2(1)[h]	0.006 -/0.014 -
Fluoride	4 mg/L	A	1497	4	0.27%	0(2) 1(1) 3(1)	5.3 -/12.3 -
Vanadium	0.038 mg/L	R	951	1	0.11%	0(1)	0.0664 J[i]
1,1-Dichloroethane	0.28 mg/L	A	86	0	0%	NA	NA
1,1-Dichloroethene	0.0070 mg/L	A	565	0	0%	NA	NA
1,2-Dichloroethane	0.0050 mg/L	A	704	0	0%	NA	NA
2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.000010 mg/L	D	19	0	0%	NA	NA
4-Methylphenol	0.029 mg/L	R	86	0	0%	NA	NA
4-Nitrophenol	0.32 mg/L	R	86	0	0%	NA	NA
alpha-Chlordane	0.0020 mg/L	A	772	0	0%	NA	NA
Aroclor-1254	0.00020 mg/L	D	86	0	0%	NA	NA
Barium	2.0 mg/L	A	194	0	0%	NA	NA
Benzene	0.0050 mg/L	A	947	0	0%	NA	NA
Beryllium	0.0040 mg/L	A	877	0	0%	NA	NA
bis(2-Chloroisopropyl) ether	0.0050 mg/L	D	459	0	0%	NA	NA
bis(2-Ethylhexyl)phthalate	0.0060 mg/L	A	86	0[j]	0%	NA[j]	NA
Bromodichloromethane	0.10 mg/L	A	771	0	0%	NA	NA
Bromomethane	0.0021 mg/L	R	86	0	0%	NA	NA
Cadmium	0.014 mg/L	B	994	0	0%	NA	NA

Table A–1 Groundwater FRL Exceedances Based on Samples and Locations Since IEMP Inception (from August 1997 through 2006) (continued)

(1) Constituents	(2) Groundwater FRL[a]	(3) Basis for FRL[b]	(4) No. of Samples[c]	(5) No. of Samples >FRL[c,d]	(6) Percent of Samples >FRL	(7) Zones with FRL Exceedances (No. of Wells with Exceedances in each Aquifer Zone)[c,d,e]	(8) Range above FRL[c,d,e]
Carbazole	0.011 mg/L	R	459	0	0%	NA	NA
Chloroethane	0.0010 mg/L	D	86	0	0%	NA	NA
Chloroform	0.10 mg/L	A	86	0	0%	NA	NA
Chromium VI	0.022 mg/L	R	16	0	0%	NA	NA
Cobalt	0.17 mg/L	R	878	0	0%	NA	NA
Copper	1.3 mg/L	A	86	0	0%	NA	NA
Mercury	0.0020 mg/L	A	2112	0[k]	0%	NA	NA
Methylene chloride	0.0050 mg/L	A	84	0	0%	NA	NA
Neptunium-237	1.0 pCi/L	R*	1606	0	0%	NA	NA
Octachlorodibenzo-p-dioxin	1.0E-7 mg/L	D	19	0	0%	NA	NA
Radium-226	20 pCi/L	A	194	0	0%	NA	NA
Radium-228	20 pCi/L	A	86	0	0%	NA	NA
Selenium	0.050 mg/L	A	991	0	0%	NA	NA
Silver	0.050 mg/L	A	856	0	0%	NA	NA
Strontium-90	8.0 pCi/L	A	1394	0	0%	NA	NA
Thorium-228	4.0 pCi/L	R*	992	0	0%	NA	NA
Thorium-230	15 pCi/L	R*	86	0	0%	NA	NA
Thorium-232	1.2 pCi/L	R*	902	0	0%	NA	NA
Vinyl chloride	0.0020 mg/L	A	771	0	0%	NA	NA

[a]From Operable Unit 5 Record of Decision, Table 9–4.
[b]From Operable Unit 5 Feasibility Study, Table 2–16:
A = ARAR-based.
B = Based on 95th percentile background concentrations.
D = Based on lowest achievable detection limit.
R = Risk-based Preliminary Remediation Goal (PRG).
R* = Risk-based Preliminary Remediation Level includes the radionuclide risk-based PRG plus its 95th percentile background concentration.
[c]Based on filtered and unfiltered samples from the August 1997 through 2006 IEMP groundwater data.
[d]Sample results having a -, J, or NV qualifier were used.
- = result is confident as reported.
J = result is quantitatively estimated.
NV = result is not validated.
[e]NA = not applicable.
[f]Nitrate/nitrite results are evaluated with respect to the nitrate FRL.
[g]Since the IEMP inception, there has been only one nitrate/nitrite exceedance at Well 2017 (in 1998) (refer to Figure A–12).
[h]Since the IEMP inception, there has been one isolated exceedance for carbon disulfide at two locations (refer to Figure A–5).
[i]Since the IEMP inception, there has been only one vanadium exceedance at Well 2426 (in 1998) (refer to Figure A–16).
[j]Of the 86 samples analyzed for bis(2-Ethylhexyl)phthalate, a common laboratory containment, five had results above the FRL. The FRL results above are all considered suspect due to laboratory analysis issues, laboratory blank and field blank contamination, or field duplicate results being non-detected. The five exceedances are as follows: 0.014J mg/L, Well 2398 and 0.010J mg/L, Well 3390 in Aquifer Zone 2; 0.016J mg/L, Well 2109 in Aquifer Zone 3; and 0.008J mg/L, Well 2125 and 0.13J mg/L, Well 3095 in Aquifer Zone 4.
[k]The mercury exceedance is suspect, due to negative MS/MSD recoveries. In fact, the MS/MSD (i.e., spiked samples) results were both extremely below the original sample result.

Table A–2. Groundwater FRL Exceedances from 1997 through 2006 Quarterly/Semiannually

		Aquifer		1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
Constituent	Well[a]	Zone	Project[b]	3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2
Antimony																																	
	2093	4	P/PB																														
	2128	4	PRRS																														
	21063	4	P/PB																														
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																								x						
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
	2398	2	P/PB																														
	2431	0	P/PB																								x						
	2432	0	P/PB																														
	2625	4	PRRS																														
	2636	4	PRRS																									x		x			
	2733	0	P/PB																														
	2898	4	PRRS																														
	2899	4	PRRS																														
	2900	4	PRRS																														
	3070	2	P/PB																														
	3093	4	P/PB																														
	31217	0	P/PB																														
	3128	4	PRRS																														
	3398	2	P/PB																														
	3424	0	P/PB																														
	3426	0	P/PB																														
	3429	0	P/PB																														
	3431	0	P/PB																														
	3432	0	P/PB																														
	3636	4	PRRS																														
	3733	0	P/PB																														
	3898	4	PRRS																														
	3899	4	PRRS																														
	3900	4	PRRS																														
	4398	2	P/PB																														

Table A−2. Groundwater FRL Exceedances from 1997 through 2006 Quarterly/Semiannually (continued)

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
				3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2
Arsenic																																	
	2093	4	PRRS																														
	2128	4	PRRS																														
	21063	4	P/PB																														
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
	2398	2	P/PB																														
	2431	0	P/PB																														
	2432	0	P/PB																														
	2625	4	PRRS												x																		
	2636	4	PRRS		x	x				x	x											x						x					
	2733	0	P/PB																														
	2898	4	PRRS											x																			
	2899	4	PRRS																														
	2900	4	PRRS											x																			
	3070	2	P/PB																														
	3093	4	P/PB																														
	31217	0	P/PB																														
	3128	4	PRRS																														
	3398	2	P/PB																														
	3424	0	P/PB																														
	3426	0	P/PB																														
	3429	0	P/PB																														
	3431	0	P/PB																														
	3432	0	P/PB																														
	3636	4	PRRS																														
	3733	0	P/PB																														
	3898	4	PRRS																														
	3899	4	PRRS																														
	3900	4	PRRS																														
	4398	2	P/PB																														

Table A−2. Groundwater FRL Exceedances from 1997 through 2006 Quarterly/Semiannually (continued)

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
				3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2
Benzene																																	
	2128	4	PRRS																														
	2625	4	PRRS																														
	2636	4	PRRS																														
	2898	4	PRRS																														
	2899	4	PRRS																														
	2900	4	PRRS																														
	3128	4	PRRS																														
	3636	4	PRRS																														
	3898	4	PRRS																														
	3899	4	PRRS																														
	3900	4	PRRS																														
Boron																																	
	2045	2	SF								x		x		x																		
	2049	2	SF	x	x			x	x	x	x	x	x	x	x		x								x								
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
Bromodichloromethane																																	
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
Carbazole																																	
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														

Table A−2. Groundwater FRL Exceedances from 1997 through 2006 Quarterly/Semiannually (continued)

		Aquifer		1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
Constituent	Well[a]	Zone	Project[b]	3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2
Carbon disulfide																																	
	2010	1	WSA																														
	2648	1	WSA																														
	2649	1	WSA						x																								
	2821	1	WSA																														
	3821	1	WSA										x																x				
Alpha-Chlordane																																	
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
Bis(2-Chloroisopropyl)ether																																	
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
1,1-Dichloroethene																																	
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF										x																				
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
Fluoride																																	
	2093	4	P/PB																														
	2128	4	PRRS																														
	21063	4	P/PB																														
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														

Table A−2. Groundwater FRL Exceedances from 1997 through 2006 Quarterly/Semiannually (continued)

		Aquifer		1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
Constituent	Well[a]	Zone	Project[b]	3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2
Fluoride (Contd)	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
	2398	2	P/PB																														
	2431	0	P/PB						x																								
	2432	0	P/PB																														
	2625	4	PRRS																														
	2636	4	PRRS																														
	2733	0	P/PB																														
	2898	4	PRRS																														
	2899	4	PRRS																														
	2900	4	PRRS																														
	3070	2	P/PB																														
	3093	4	P/PB																														
	31217	0	P/PB																														
	3128	4	PRRS																														
	3398	2	P/PB																														
	3424	0	P/PB																														
	3426	0	P/PB																														
	3429	0	P/PB																														
	3431	0	P/PB																														
	3432	0	P/PB																														
	3636	4	PRRS																														
	3733	0	P/PB																														
	3898	4	P/PB																														
	3899	4	P/PB																														
	3900	4	P/PB																														
	4398	2	P/PB																														
Lead																																	
	2093	4	P/PB																														
	2128	4	PRRS																														
	21063	4	P/PB																														
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														

Table A−2. Groundwater FRL Exceedances from 1997 through 2006 Quarterly/Semiannually (continued)

		Aquifer		1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
Constituent	Well[a]	Zone	Project[b]	3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2
Lead (Cont.)																																	
	2398	2	PRRS																														
	2431	0	PRRS											x																			
	2432	0	PRRS																														
	2625	4	PRRS																														
	2636	4	PRRS																														
	2733	0	PRRS																														
	2898	4	PRRS																														
	2899	4	PRRS																														
	2900	4	PRRS																														
	3070	2	P/PB																														
	3093	4	P/PB																														
	31217	0	P/PB																														
	3128	4	PRRS																														
	3398	2	P/PB																														
	3424	0	P/PB																														
	3426	0	P/PB																														
	3429	0	P/PB																														
	3431	0	P/PB																														
	3432	0	P/PB																														
	3636	4	PRRS																														
	3733	0	P/PB	x													x																
	3898	4	PRRS																														
	3899	4	PRRS																														
	3900	4	PRRS																														
	4398	2	P/PB																														
Manganese																																	
	2010	1	WSA													x				x						x	x	x	x		x	x	x
	2093	4	P/PB																														
	2128	4	PRRS																														
	21063	4	P/PB																														
	22198	0	OSDF																					x									
	22199	0	OSDF																														
	22204	0	OSDF																							x			x	x	x	x	x
	22205	0	OSDF																												x		
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
	2398	2	P/PB																														
	2431	0	P/PB			x	x																										
	2432	0	P/PB														x			x	x		x			x							
	2625	4	PRRS																														
	2636	4	PRRS																														

Table A−2. Groundwater FRL Exceedances from 1997 through 2006 Quarterly/Semiannually (continued)

		Aquifer		1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
Constituent	Well[a]	Zone	Project[b]	3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2
Manganese (Cont.)	**2648**	1	WSA		x				x				x		x				x				x						x	x		x	
	2649	1	WSA																														
	2733	0	P/PB																														
	2821	1	WSA																														
	2898	4	PRRS																				x					x					
	2899	4	PRRS													x																	
	2900	4	PRRS													x																	
	3070	2	P/PB																														
	3093	4	P/PB																														
	31217	0	P/PB																														
	3128	4	PRRS																														
	3398	2	P/PB																														
	3424	0	P/PB																														
	3426	0	P/PB																														
	3429	0	P/PB																														
	3431	0	P/PB																														
	3432	0	P/PB																														
	3636	4	PRRS																														
	3733	0	P/PB																														
	3821	1	WSA										x		x				x				x			x	x	x			x	x	
	3898	4	PRRS																														
	3899	4	PRRS																														
	3900	4	PRRS																														
	4398	2	P/PB																														
	83337_C1	1	WSA																														
	83337_C2	1	WSA																														
	83337_C3	1	WSA																														
	83338_C1	1	WSA																														
	83338_C2	1	WSA																														
	83338_C3	1	WSA																														
Mercury																																	
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														

Table A−2. Groundwater FRL Exceedances from 1997 through 2006 Quarterly/Semiannually (continued)

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
				3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2
Molybdenum																																	
	2010	1	WSA																														
	2648	1	WSA																														
	2649	1	WSA	x					x				x		x				x				x			x	x	x	x	x	x	x	
	2821	1	WSA																														
	3821	1	WSA																														
	83337_C1	1	WSA																														
	83337_C2	1	WSA																														
	83337_C3	1	WSA																														
	83338_C1	1	WSA																														
	83338_C2	1	WSA																														
	83338_C3	1	WSA																														
Nickel																																	
	2093	4	P/PB																														
	2128	4	PRRS																														
	21063	4	P/PB																														
	22198	0	OSDF										x																				
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
	2398	2	P/PB	x		x	x	x	x			x	x																				
	2431	0	P/PB																														
	2432	0	P/PB																														
	2625	4	PRRS																														
	2636	4	PRRS																														
	2733	0	P/PB																														
	2898	4	PRRS																														
	2899	4	PRRS																														
	2900	4	PRRS																														
	3070	2	P/PB																														
	3093	4	P/PB																														
	31217	0	P/PB																														
	3128	4	PRRS																														
	3398	2	P/PB																														
	3424	0	P/PB																														
	3426	0	P/PB																														
	3429	0	P/PB																														

Table A–2. Groundwater FRL Exceedances from 1997 through 2006 Quarterly/Semiannually (continued)

		Aquifer		1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
Constituent	Well[a]	Zone	Project[b]	3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2
Nickel (Cont.)	3431	0	P/PB																														
	3432	0	P/PB																														
	3636	4	PRRS																														
	3733	0	P/PB																														
	3898	4	PRRS																														
	3899	4	PRRS																														
	3900	4	PRRS																														
	4398	2	P/PB							x				x																			
	83337_C1	1	WSA																														
	83337_C2	1	WSA																														
	83337_C3	1	WSA																														
	83338_C1	1	WSA																														
	83338_C2	1	WSA																														
	83338_C3	1	WSA																														
Nitrate/Nitrite																																	
	2010	1	WSA																														
	2648	1	WSA				x						x		x			x									x	x	x			x	
	2649	1	WSA		x		x		x		x		x		x		x	x	x	x	x	x	x		x	x	x	x	x		x	x	
	2821	1	WSA										x													x				x		x	x
	3821	1	WSA														x				x										x		
	83337_C1	1	WSA																														
	83337_C2	1	WSA																														
	83337_C3	1	WSA																														
	83338_C1	1	WSA																														
	83338_C2	1	WSA																														
	83338_C3	1	WSA																														
Technetium-99																																	
	2010	1	WSA																														
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
	2648	1	WSA										x					x	x							x							
	2649	1	WSA		x		x		x		x		x		x		x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	
	2821	1	WSA										x												x	x	x	x	x	x	x	x	x
	3821	1	WSA																														
	83337_C1	1	WSA																														

Table A−2. Groundwater FRL Exceedances from 1997 through 2006 Quarterly/Semiannually (continued)

		Aquifer		1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
Constituent	Well[a]	Zone	Project[b]	3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2
Technetium-99 (cont.)	83337_C2	1	WSA																														
	83337_C3	1	WSA																														
	83338_C1	1	WSA																														
	83338_C2	1	WSA																														
	83338_C3	1	WSA																														
Trichloroethene																																	
	2010	1	WSA																														
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
	2648	1	WSA																														
	2649	1	WSA						x				x		x				x				x			x	x	x	x	x	x	x	
	2821	1	WSA																														
	3821	1	WSA																														
Vinyl Chloride																																	
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
Zinc																																	
	2093	4	P/PB																														
	2128	4	PRRS																														
	21063	4	P/PB																														
	22198	0	OSDF																														
	22199	0	OSDF																							x							
	22204	0	OSDF																							x							
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																											x		x	
	22211	0	OSDF																														
	22214	0	OSDF																														
	2398	2	P/PB				x																										

Table A−2. Groundwater FRL Exceedances from 1997 through 2006 Quarterly/Semiannually (continued)

		Aquifer		1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
Constituent	Well[a]	Zone	Project[b]	3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2
Zinc (Cont.)	**2431**	0	P/PB					x	x					x																			
	2432	0	P/PB							x				x			x																
	2625	4	PRRS																														
	2636	4	PRRS																														
	2733	0	P/PB								x																						
	2898	4	PRRS																														
	2899	4	PRRS																														
	2900	4	PRRS													x												x					
	3070	2	P/PB																														
	3093	4	P/PB																														
	31217	0	P/PB																														
	3128	4	PRRS																											x			
	3398	2	P/PB																														
	3424	0	P/PB																														
	3426	0	P/PB								x		x																				
	3429	0	P/PB							x	x																						
	3431	0	P/PB																			x											
	3432	0	P/PB																														
	3636	4	PRRS																														
	3733	0	P/PB																							x							
	3898	4	PRRS																														
	3899	4	PRRS																	x													
	3900	4	PRRS																														

Note: Shading indicates well is outside the Waste Storage Area (Phase-II) design remediation footprint.
[a]As defined in the IEMP, Rev. 3, all monitoring is now semiannual. Well numbers that are **bold** have historical FRL exceedances.
[b]WSA = Waste Storage Area
SF = South Field
P/PB = Property/Plume Boundary for FRL Exceedances
PRRS = Property/Plume Boundary for Paddys Run Road Site
OSDF = Property/Plume Boundary for on-site disposal facility
[c]Sampling for the IEMP was initiated in August 1997.

Table A−3. IEMP Non-Uranium Constituents with FRL Exceedances, Location of Exceedances, and Revised Monitoring Program

Parameter	Aquifer Zones with Exceedances	Monitoring Program
Antimony	Multiple Zones	Property/Plume Boundary
Arsenic	Multiple Zones	Property/Plume Boundary
Boron	Aquifer Zone 2 (South Field)	South Field
Carbon Disulfide	Aquifer Zone 1 (Waste Storage Area)	Waste Storage Area
Fluoride	Multiple Zones	Property/Plume Boundary
Lead	Multiple Zones	Property/Plume Boundary
Manganese	Multiple Zones[a]	Property/Plume Boundary, Waste Storage Area
Molybdenum	Aquifer Zone 1 (Waste Storage Area)	Waste Storage Area
Nickel	Multiple Zones	Property/Plume Boundary Waste Storage Area
Nitrate/Nitrite	Aquifer Zone 1 (Waste Storage Area)	Waste Storage Area
Technetium-99	Aquifer Zone 1 (Waste Storage Area)	Waste Storage Area
Trichloroethene	Aquifer Zone 1 (Waste Storage Area)	Waste Storage Area
Zinc	Multiple Zones	Property/Plume Boundary

[a]There are consistent/recent exceedances of manganese in Zone 1; therefore, this constituent will be monitored in the waste storage area.

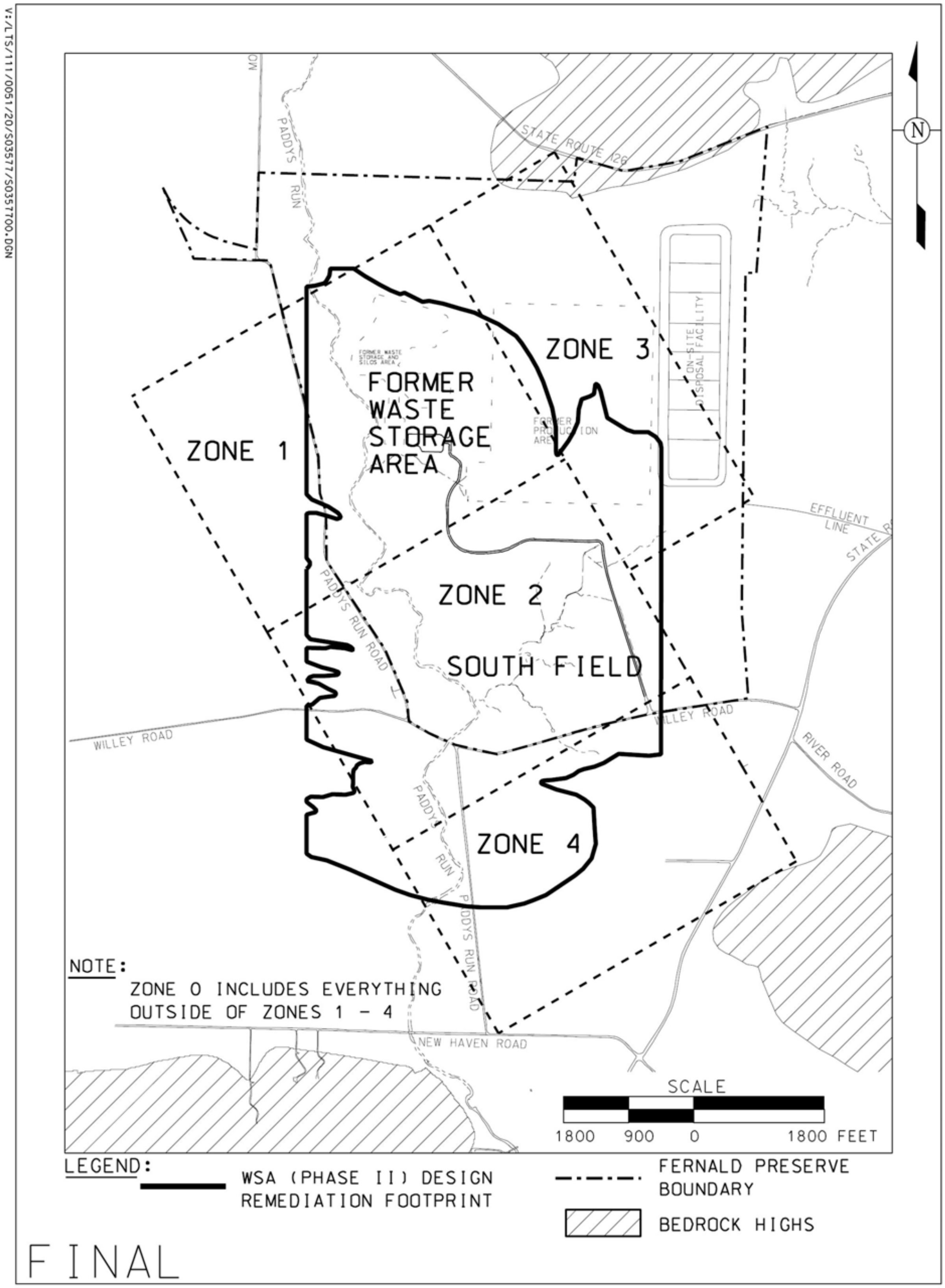

Figure A−1. Groundwater Aquifer Zones and Aquifer Restoration Footprint

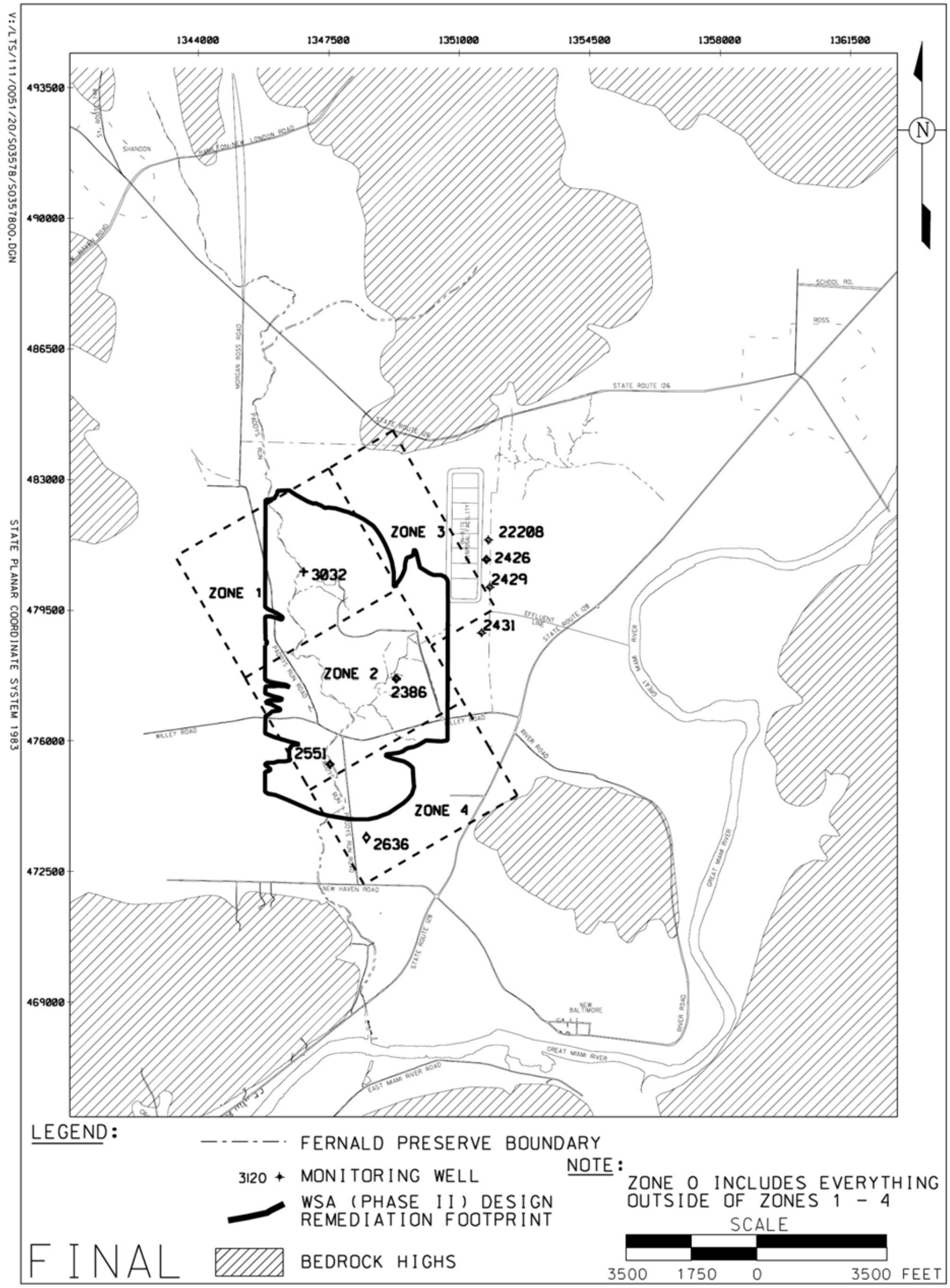

Figure A−2. Monitoring Well Locations with Concentrations Above the FRL for Antimony

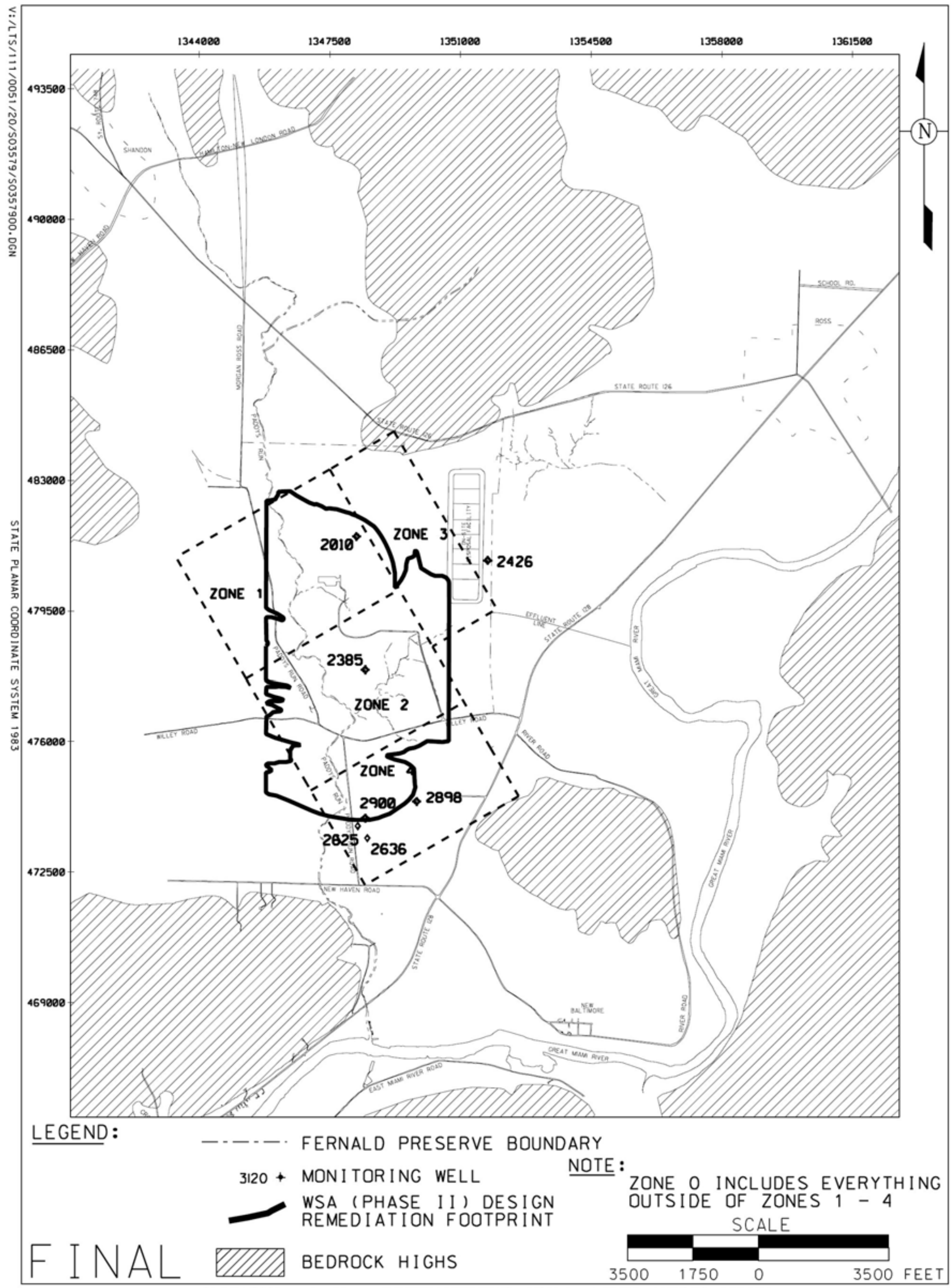

Figure A−3. Monitoring Well Locations with Concentrations Above the FRL for Arsenic

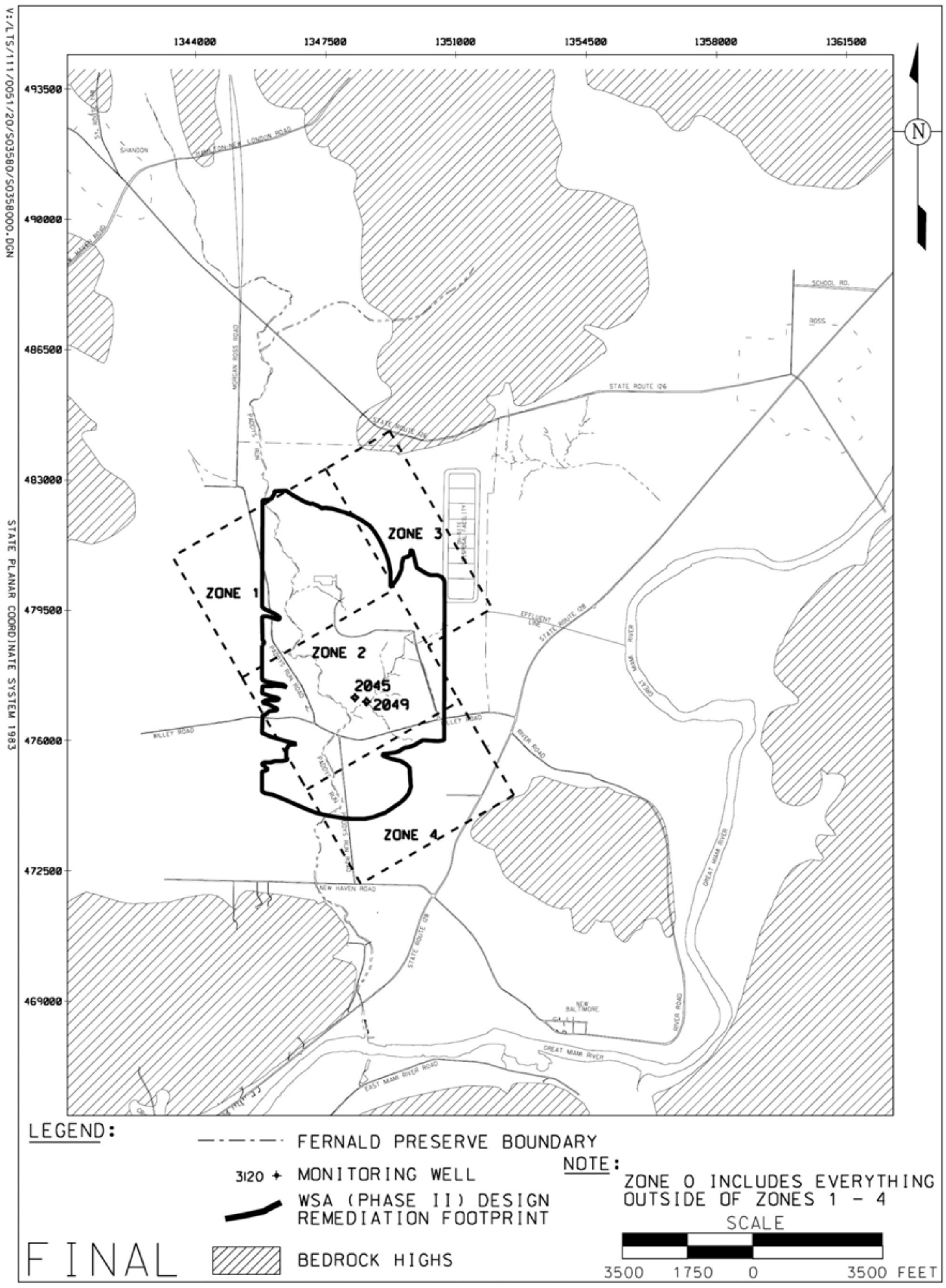

Figure A−4. Monitoring Well Locations with Concentrations Above the FRL for Boron

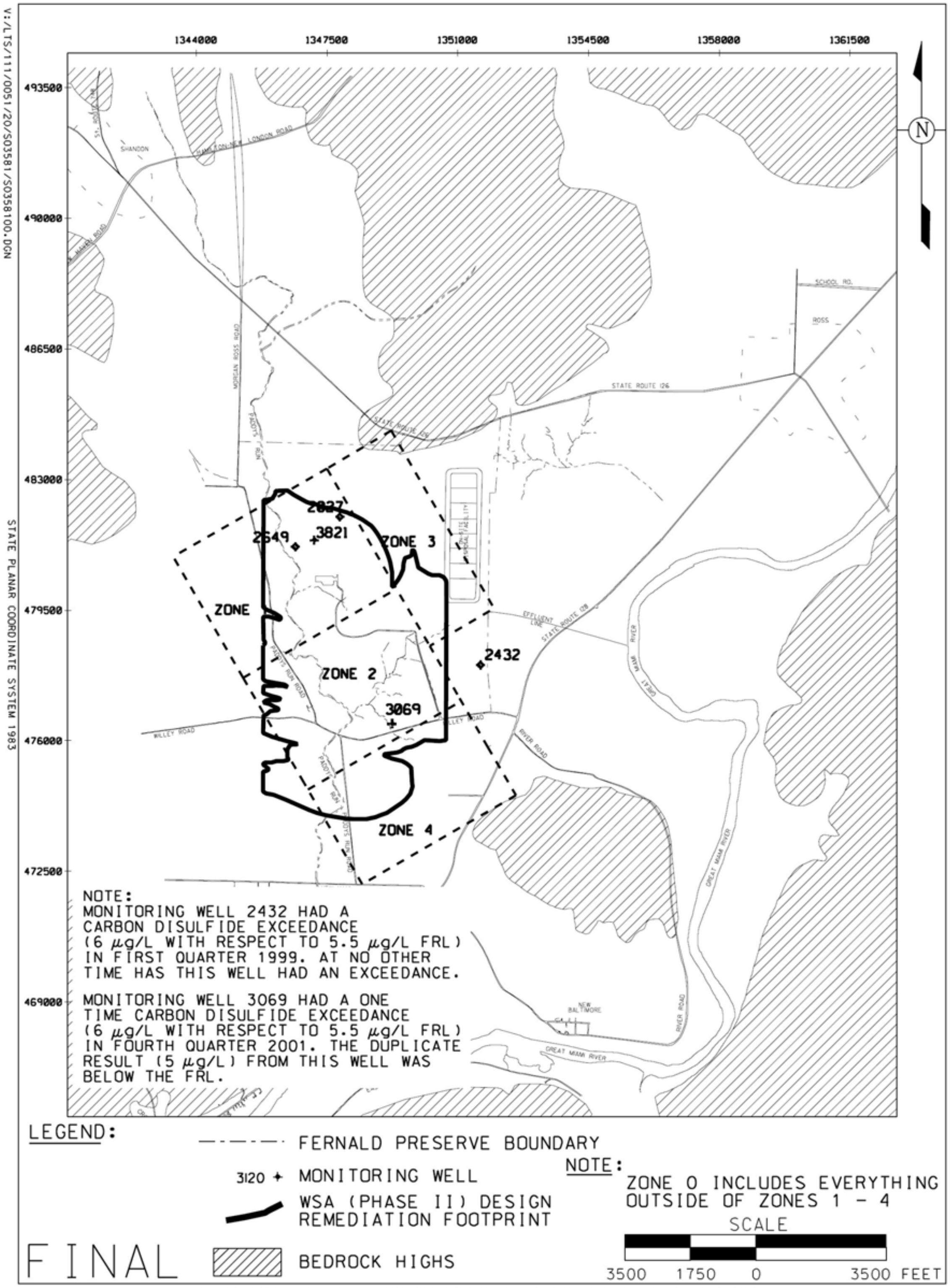

Figure A−5. Monitoring Well Locations with Concentrations Above the FRL for Carbon Disulfide

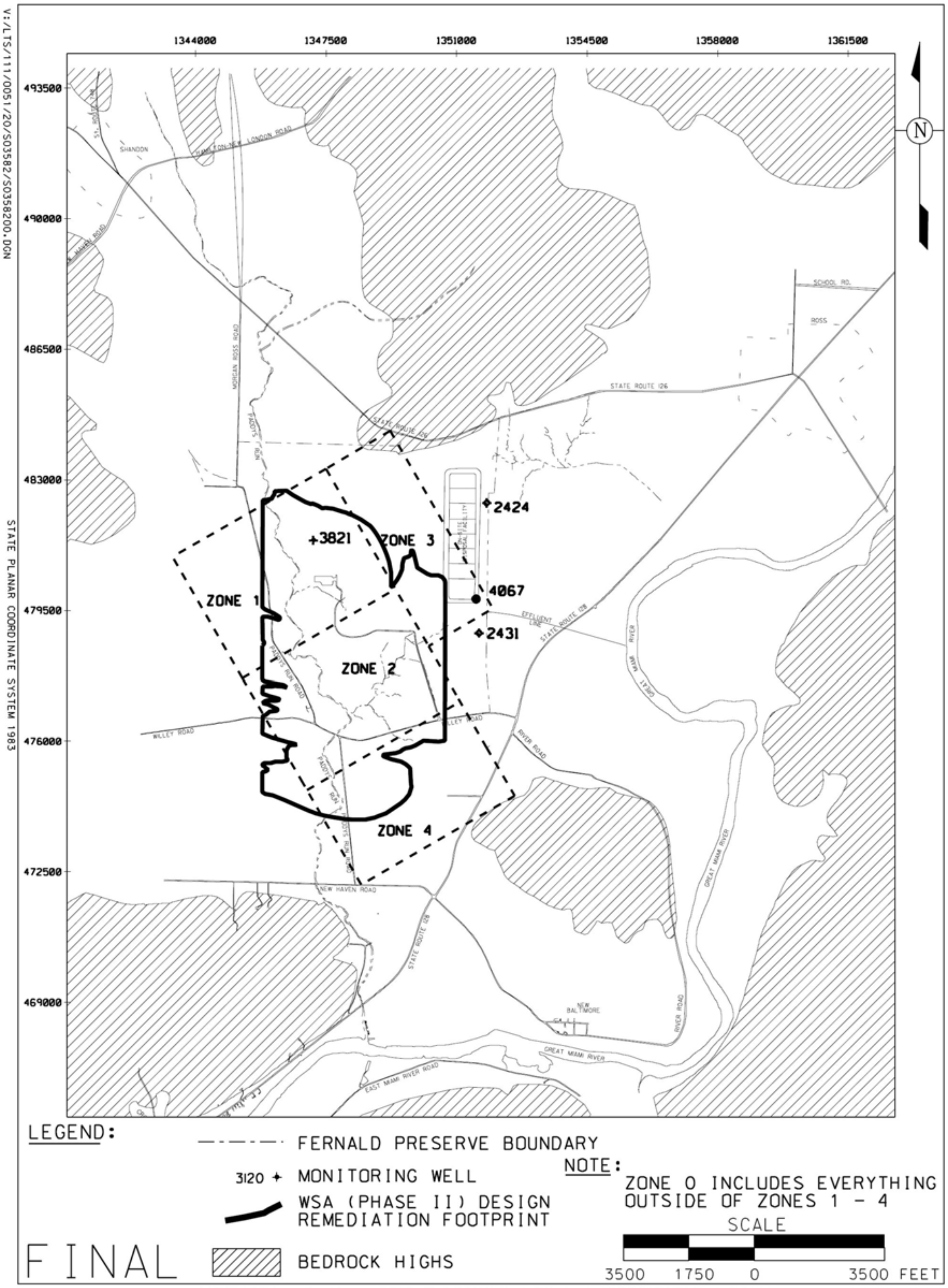

Figure A−6. Monitoring Well Locations with Concentrations Above the FRL for Flouride

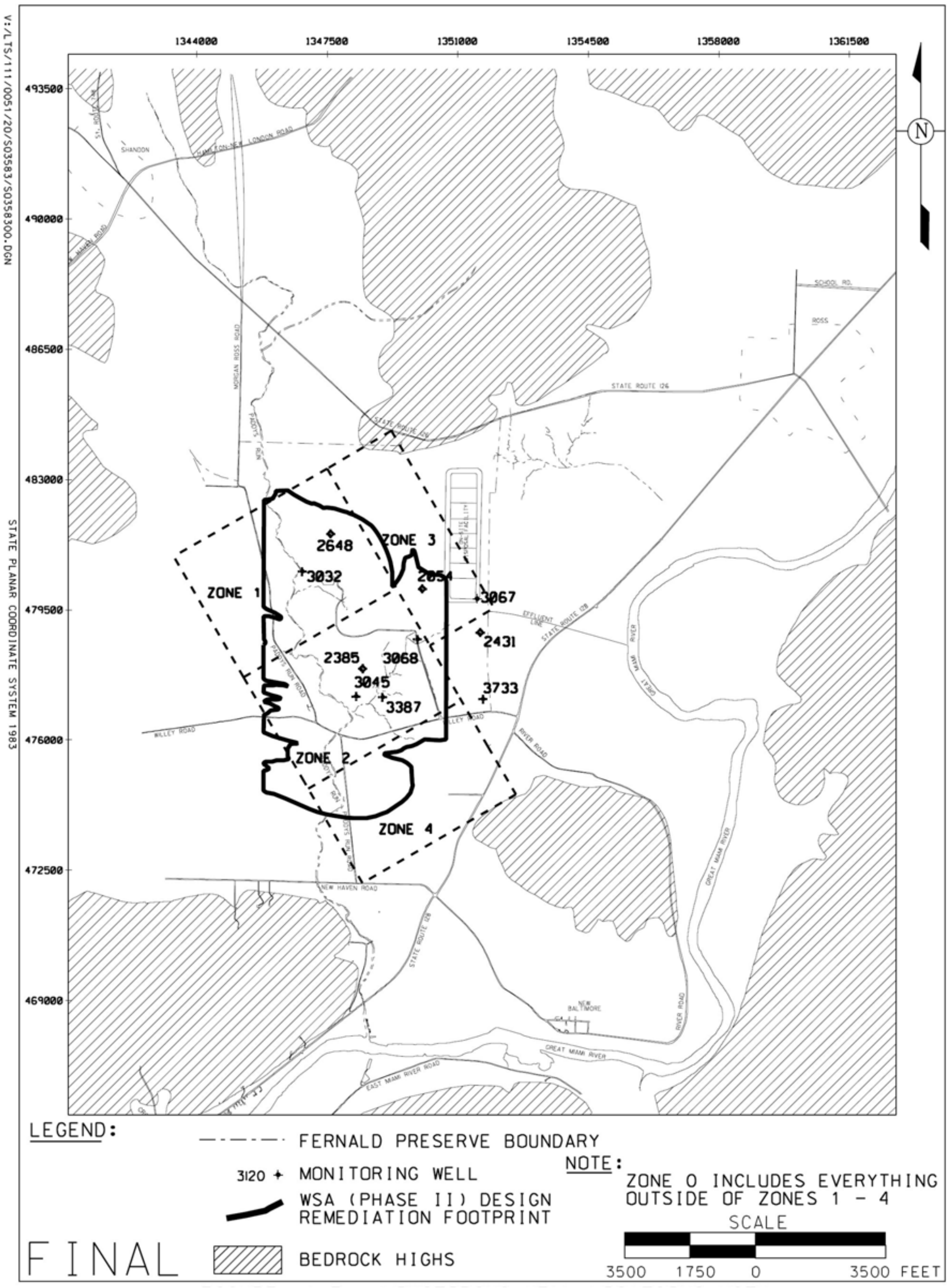

Figure A−7. Monitoring Well Locations with Concentrations Above the FRL for Lead

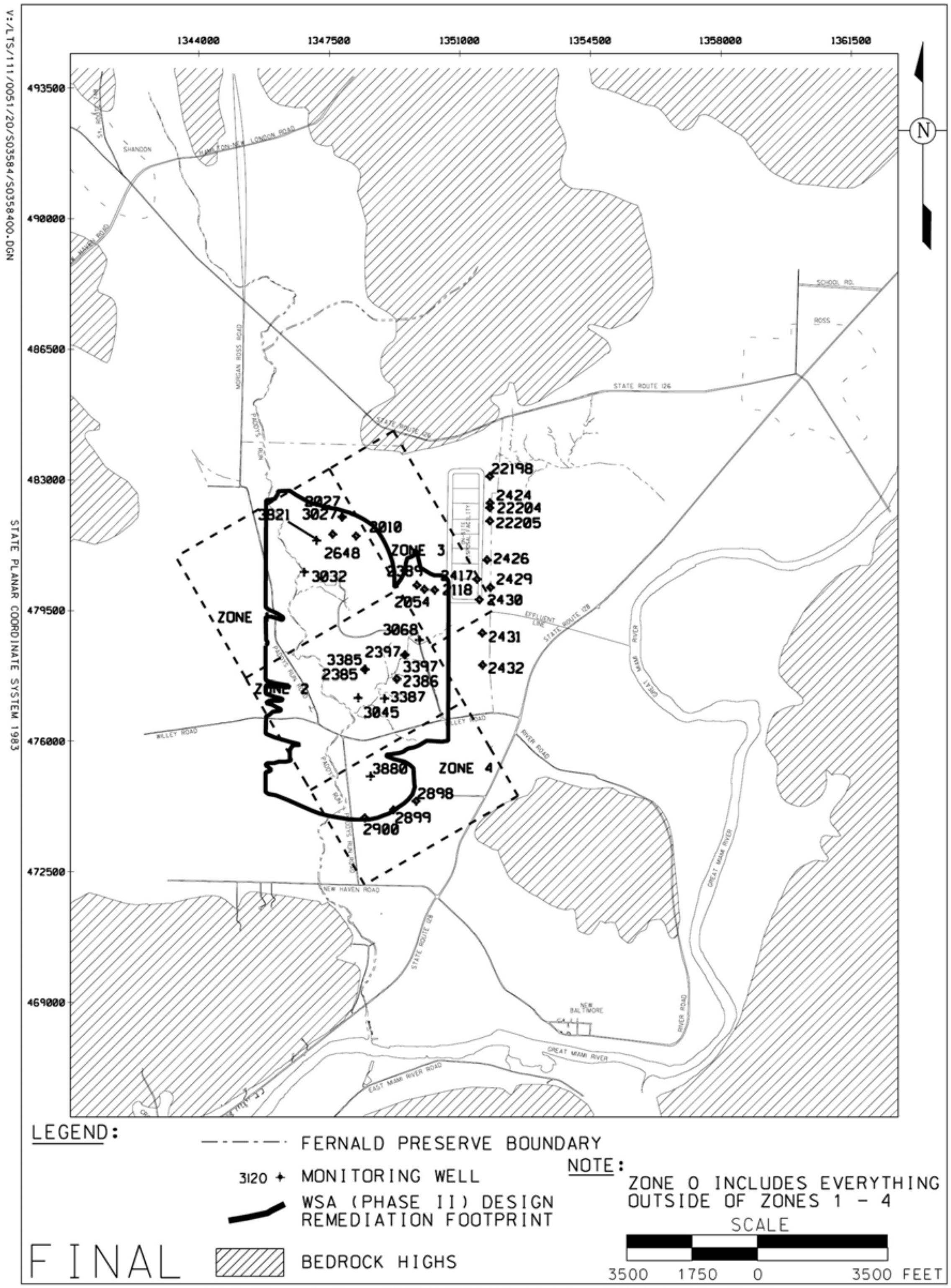

Figure A−8. Monitoring Well Locations with Concentrations Above the FRL for Manganese

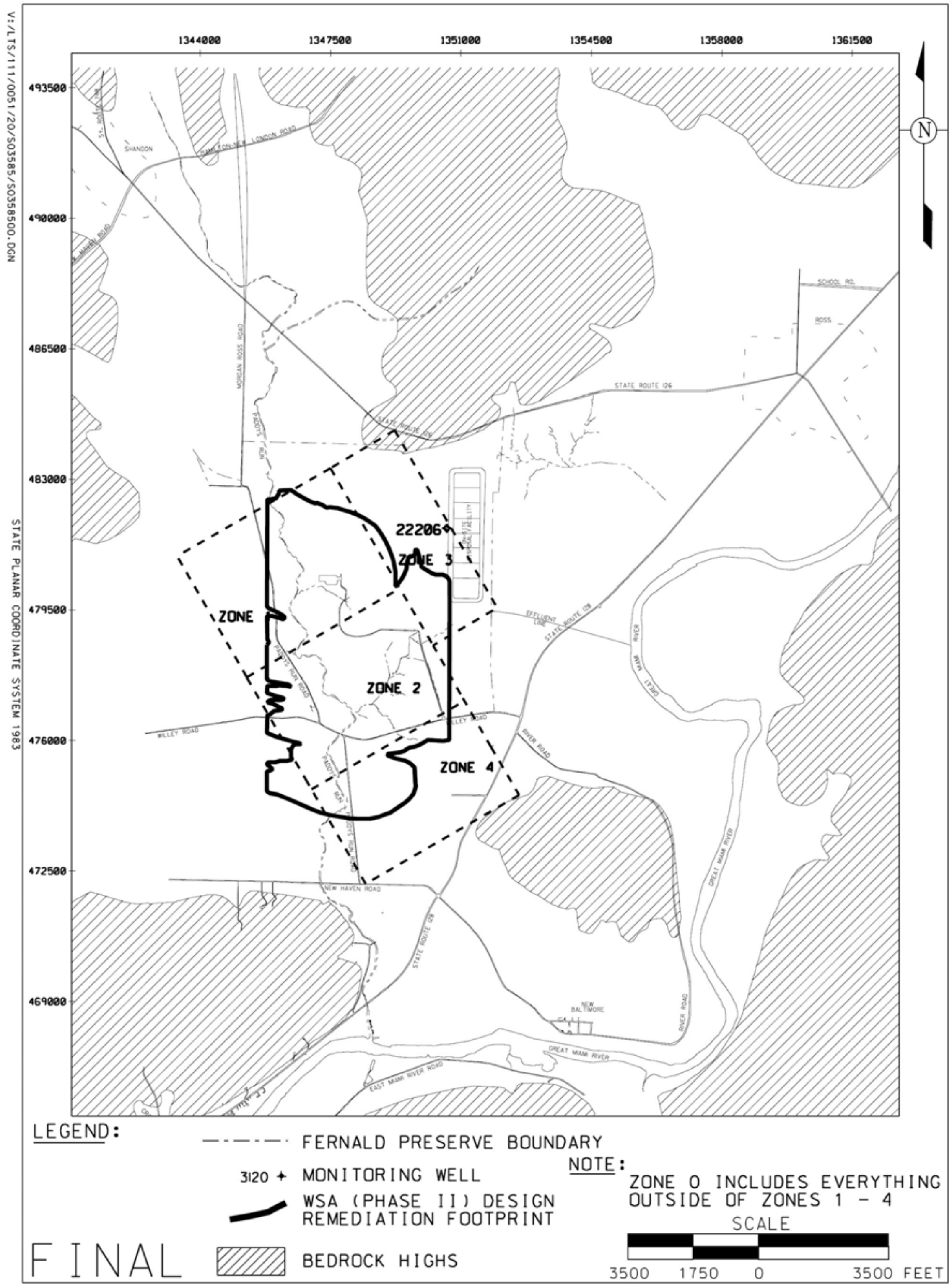

Figure A−9. Monitoring Well Locations with Concentrations Above the FRL for Mercury

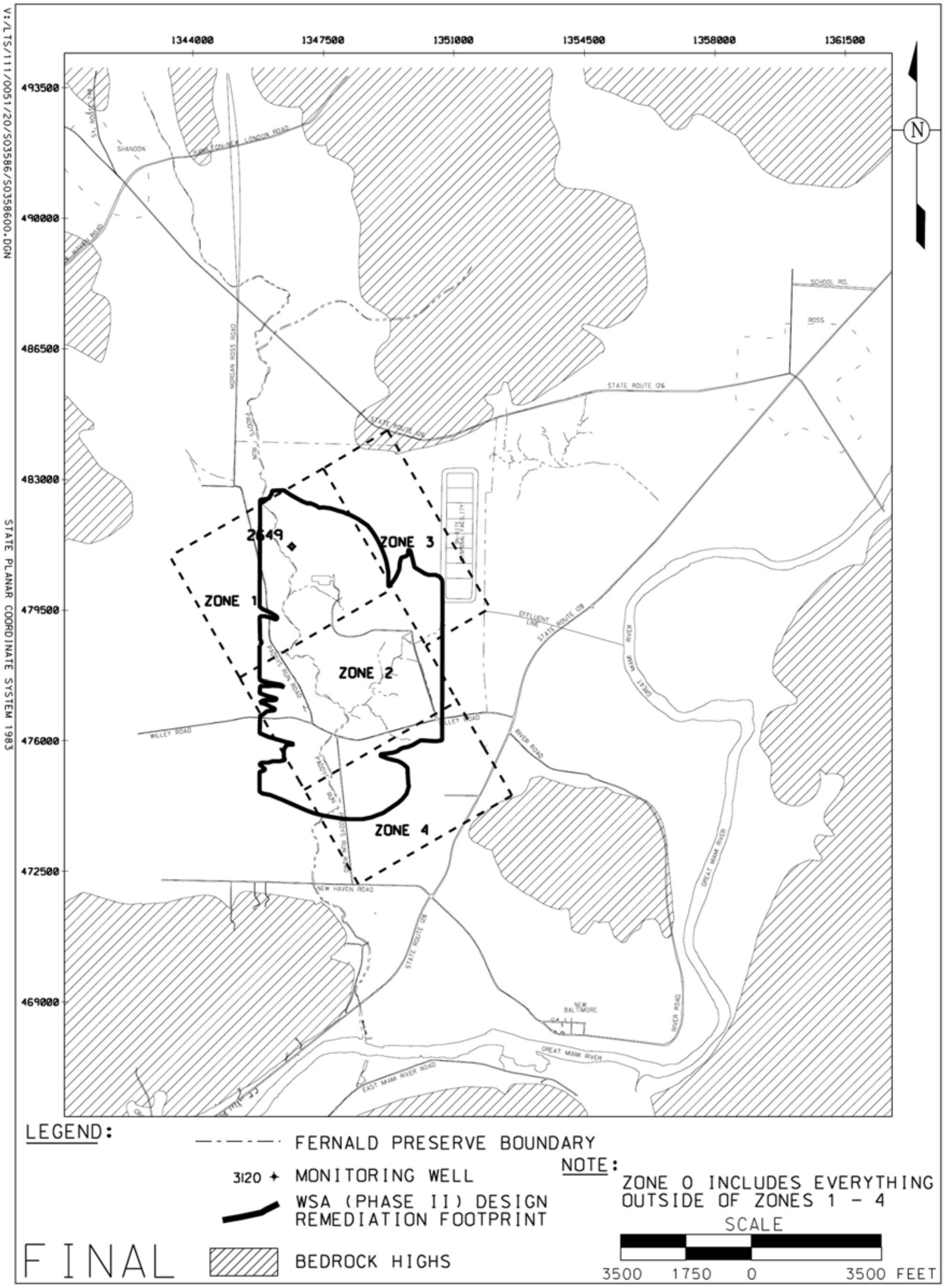

Figure A−10. Monitoring Well Locations with Concentrations Above the FRL for Molybdenum

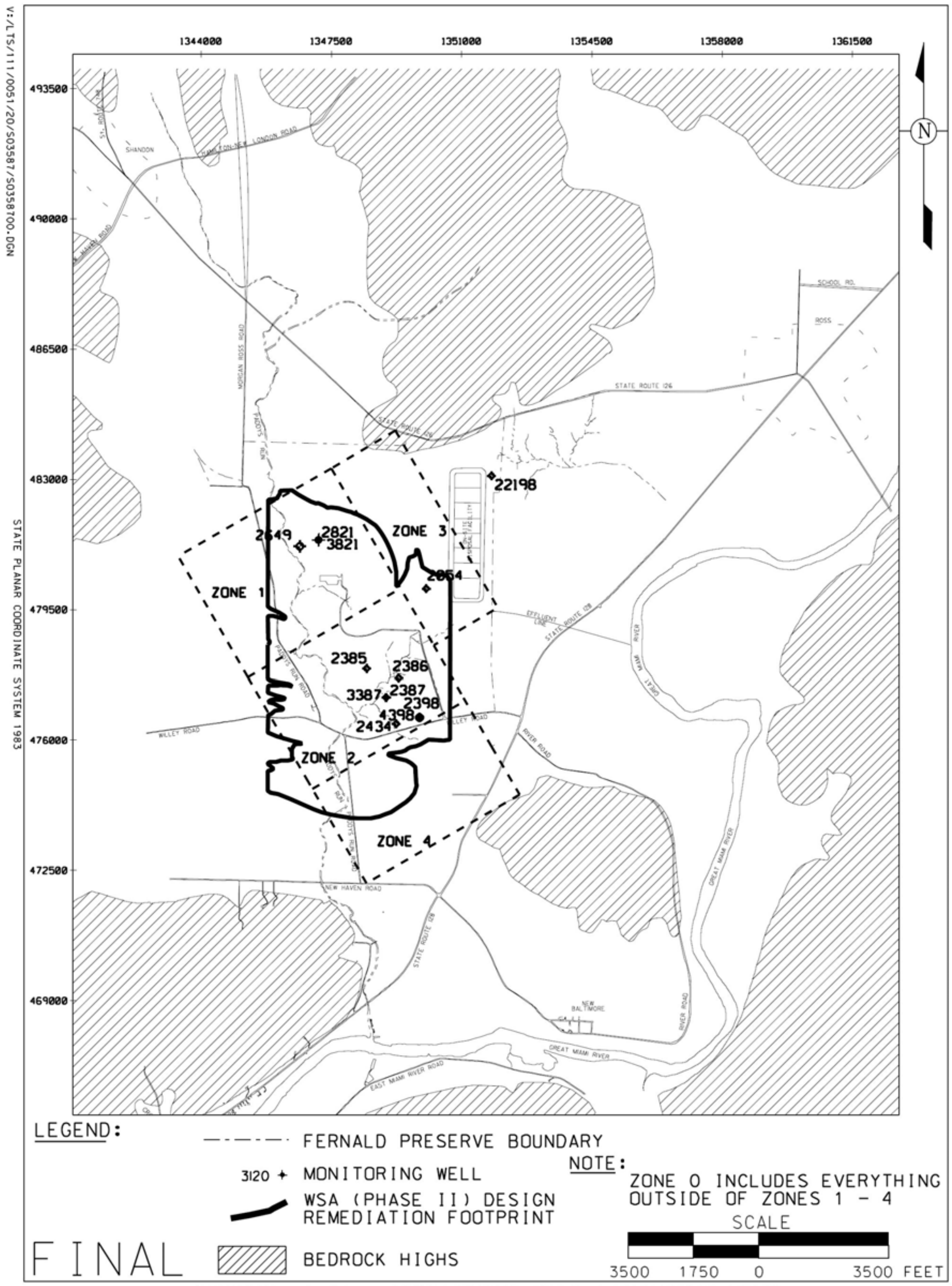

Figure A−11. Monitoring Well Locations with Concentrations Above the FRL for Nickel

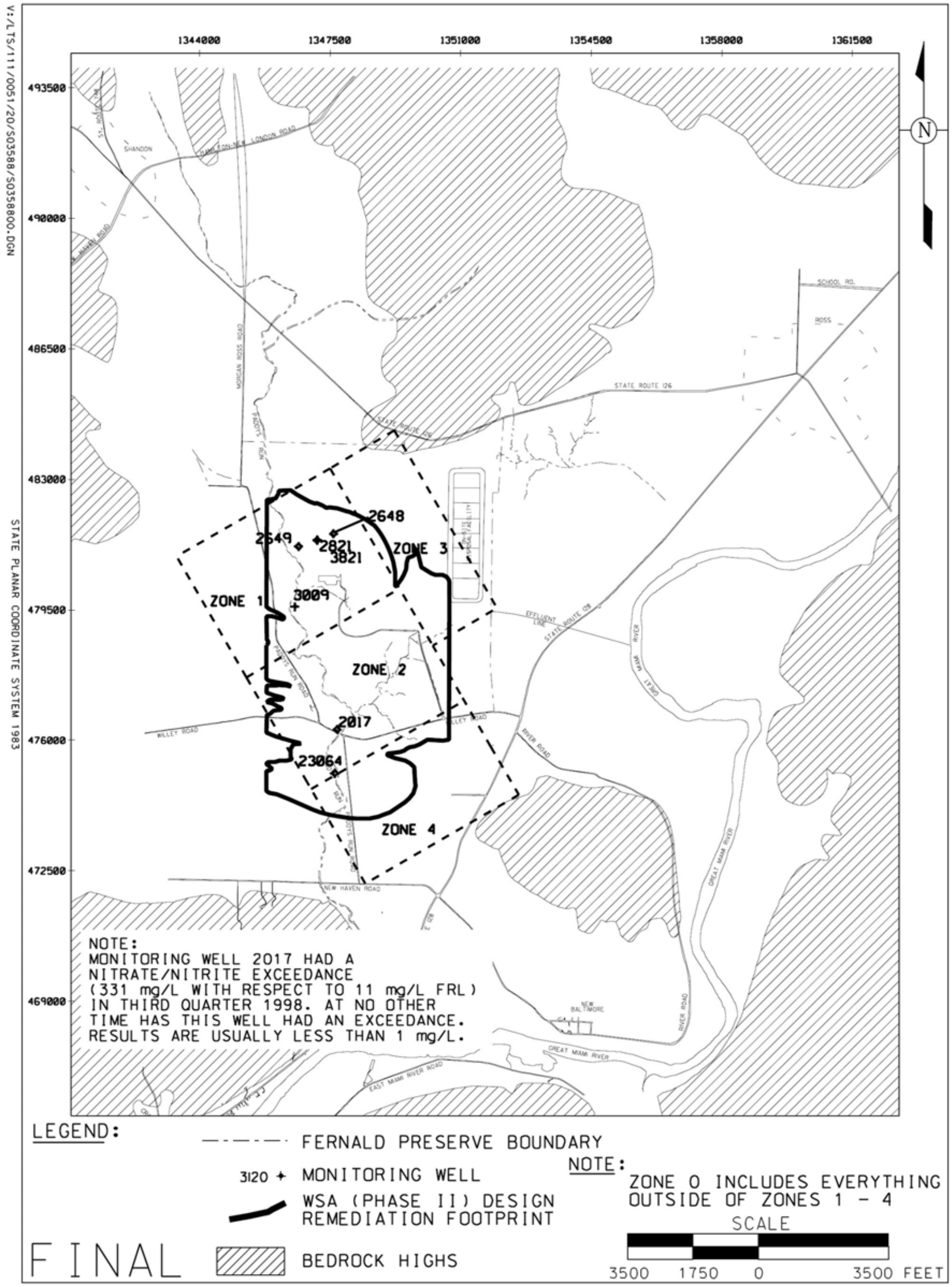

Figure A−12. Monitoring Well Locations with Concentrations Above the FRL for Nitrate/Nitrite

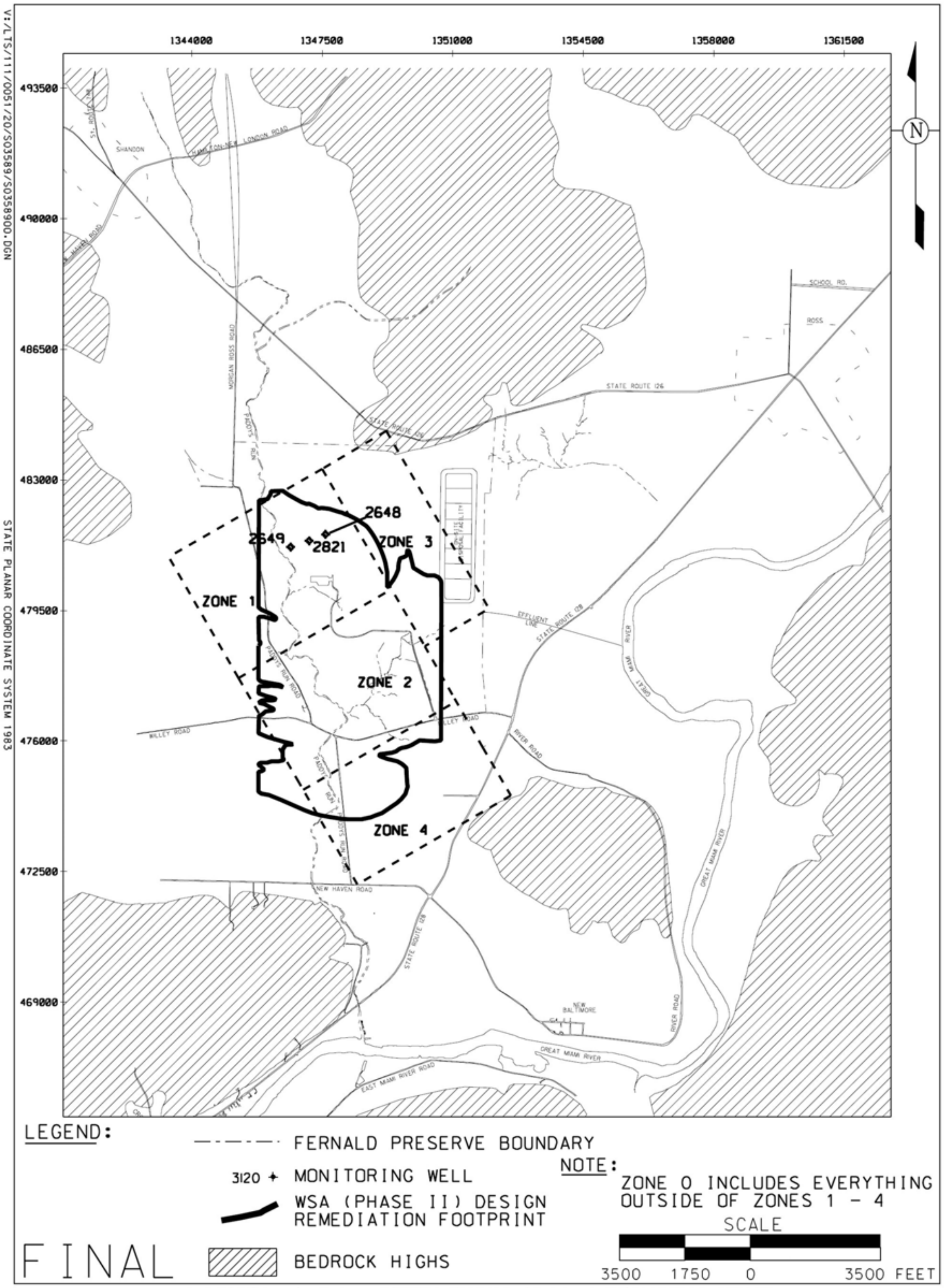

Figure A−13. Monitoring Well Locations with Concentrations Above the FRL for Technetium-99

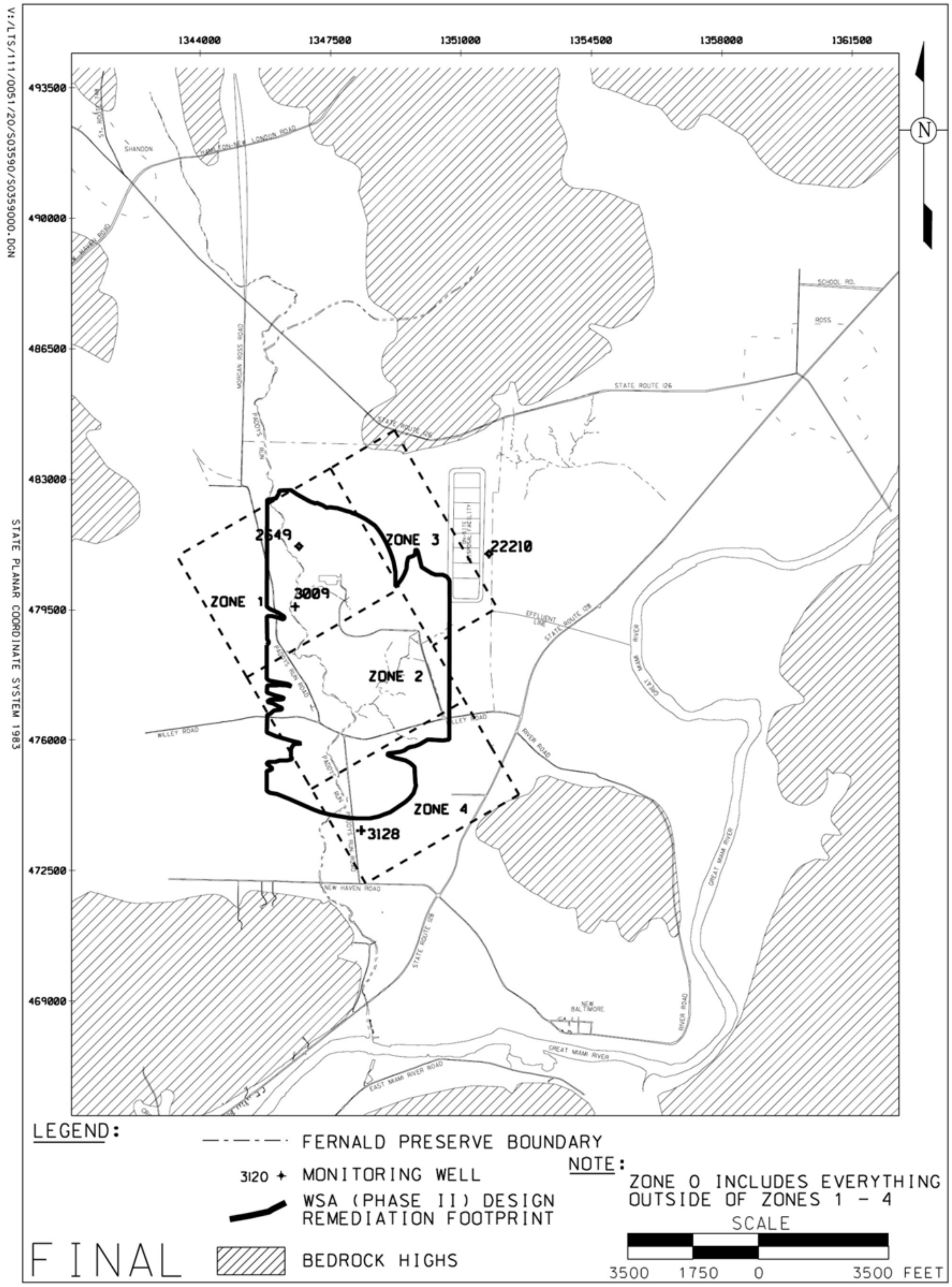

Figure A−14. Monitoring Well Locations with Concentrations Above the FRL for Trichloroethene

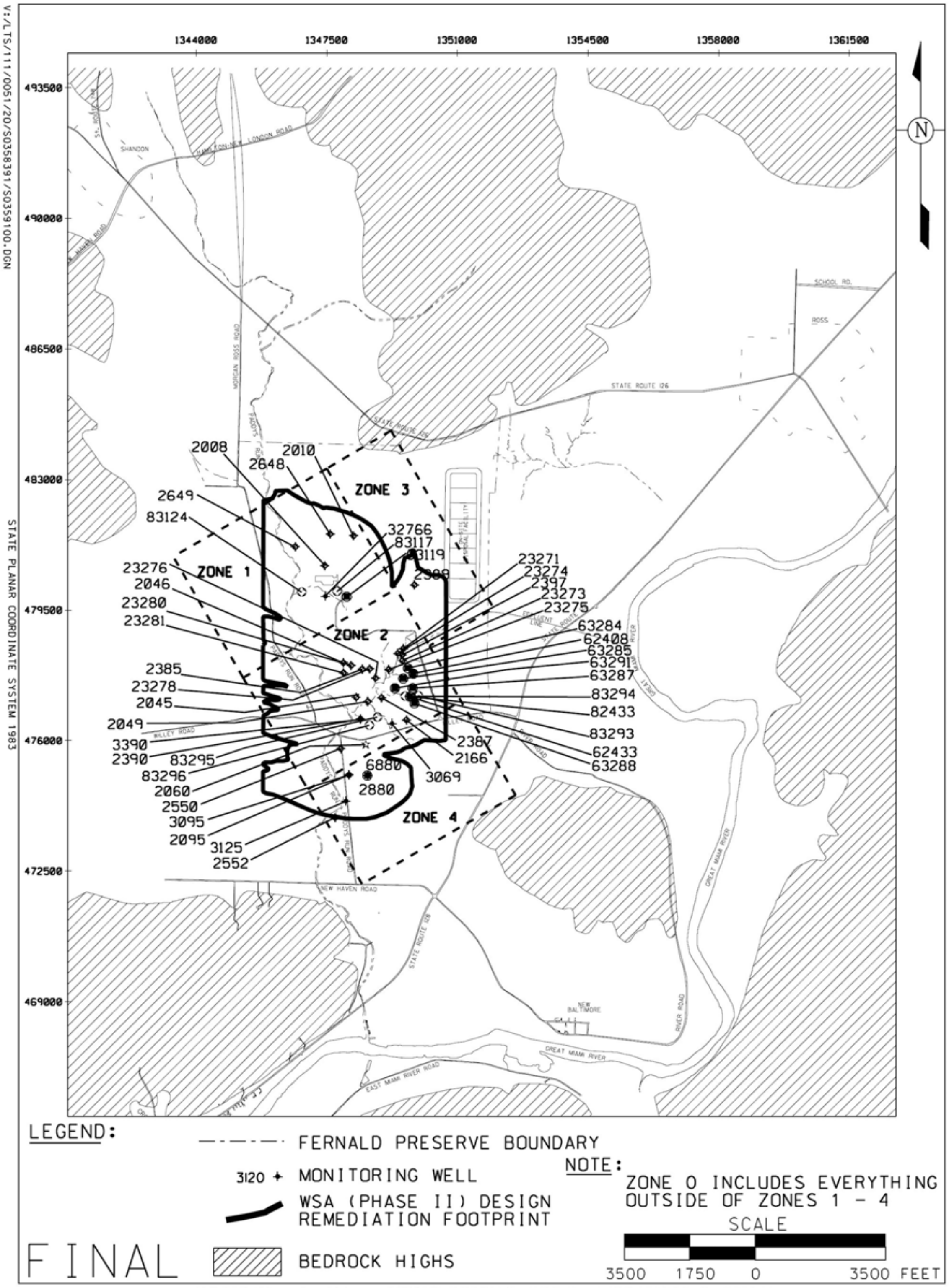

Figure A−15. Monitoring Well Locations with Concentrations Above the FRL for Uranium

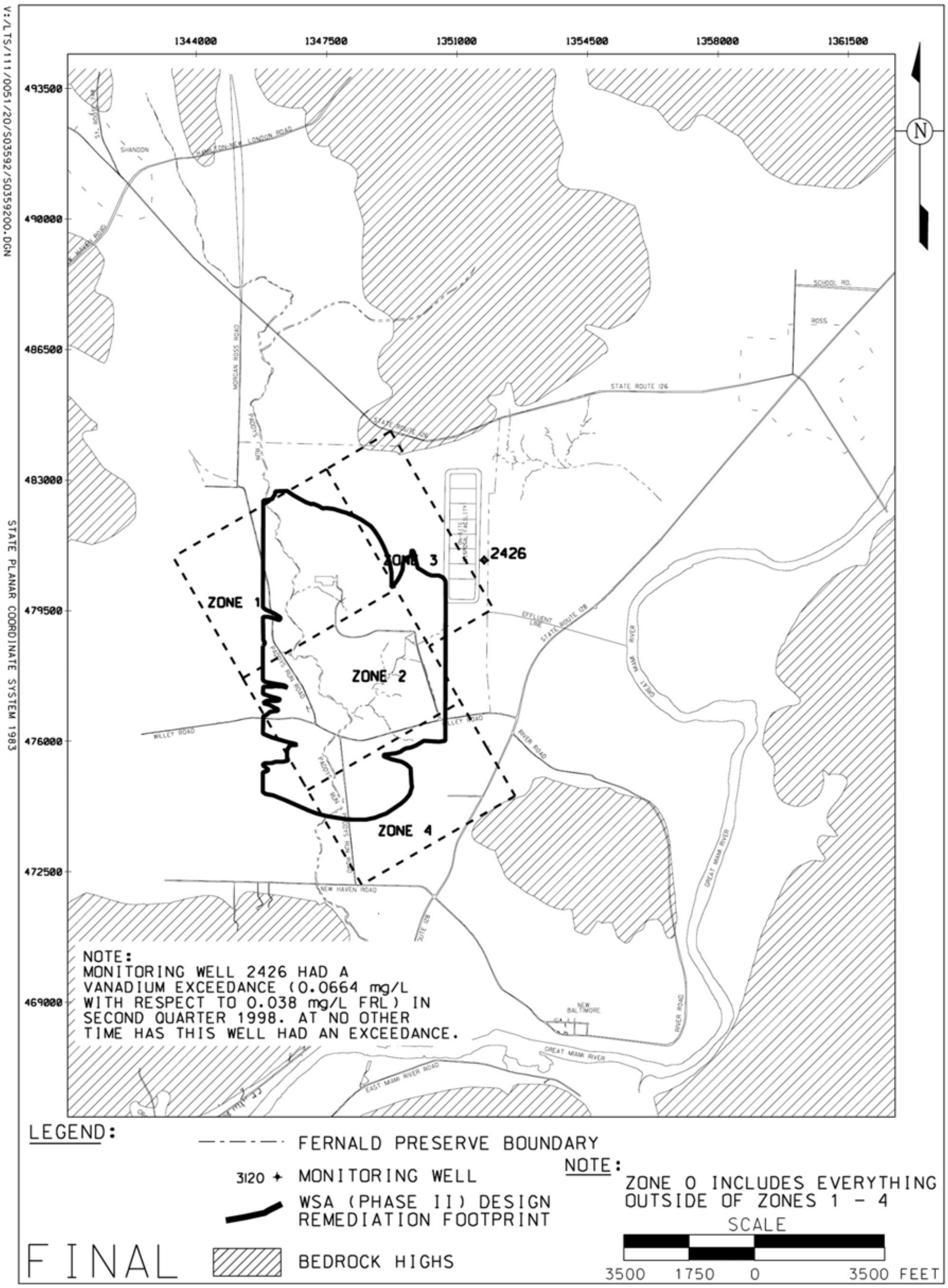

Figure A−16. Monitoring Well Locations with Concentrations Above the FRL for Vanadium

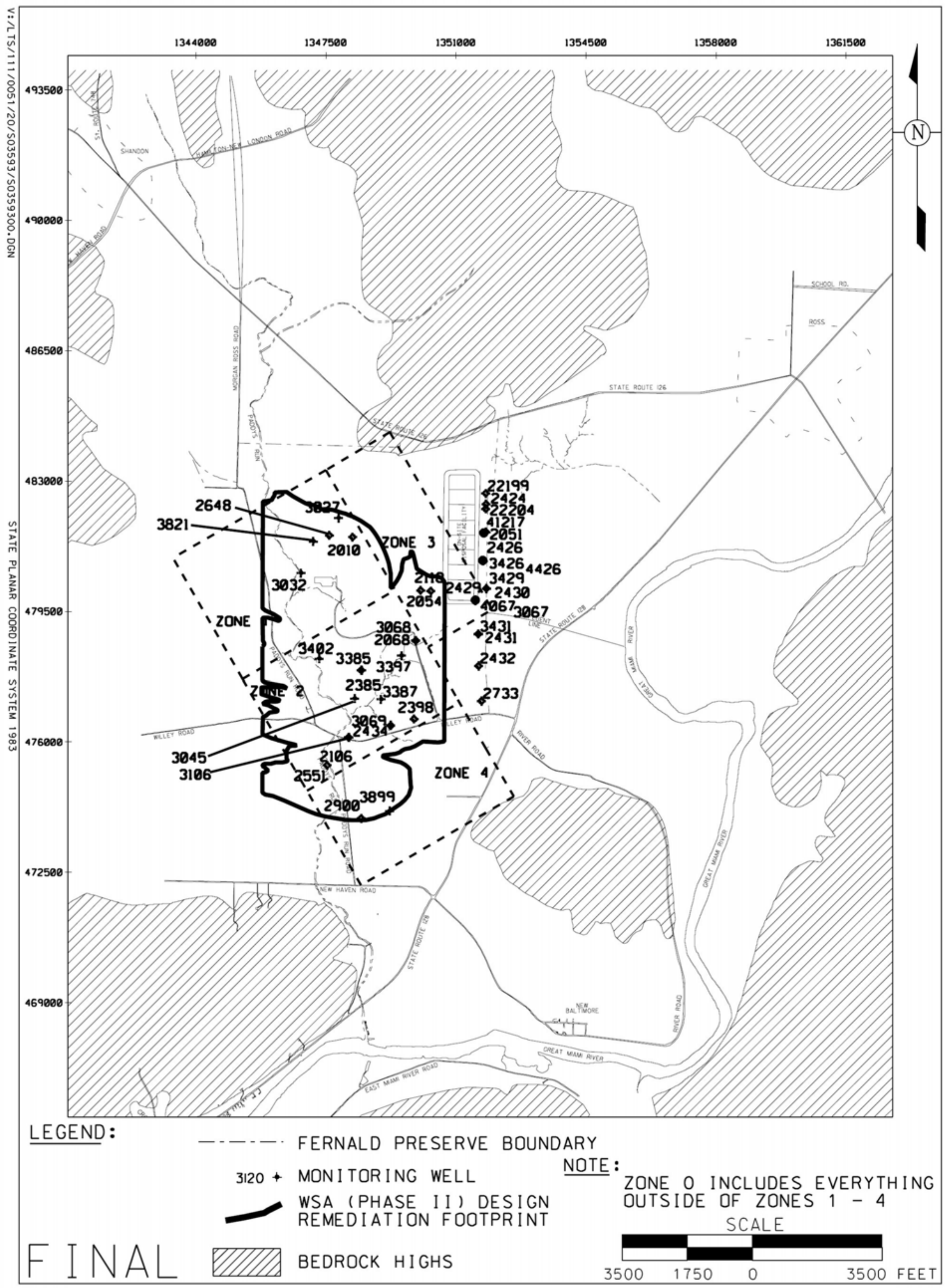

Figure A–17. Monitoring Well Locations with Concentrations Above the FRL for Zinc

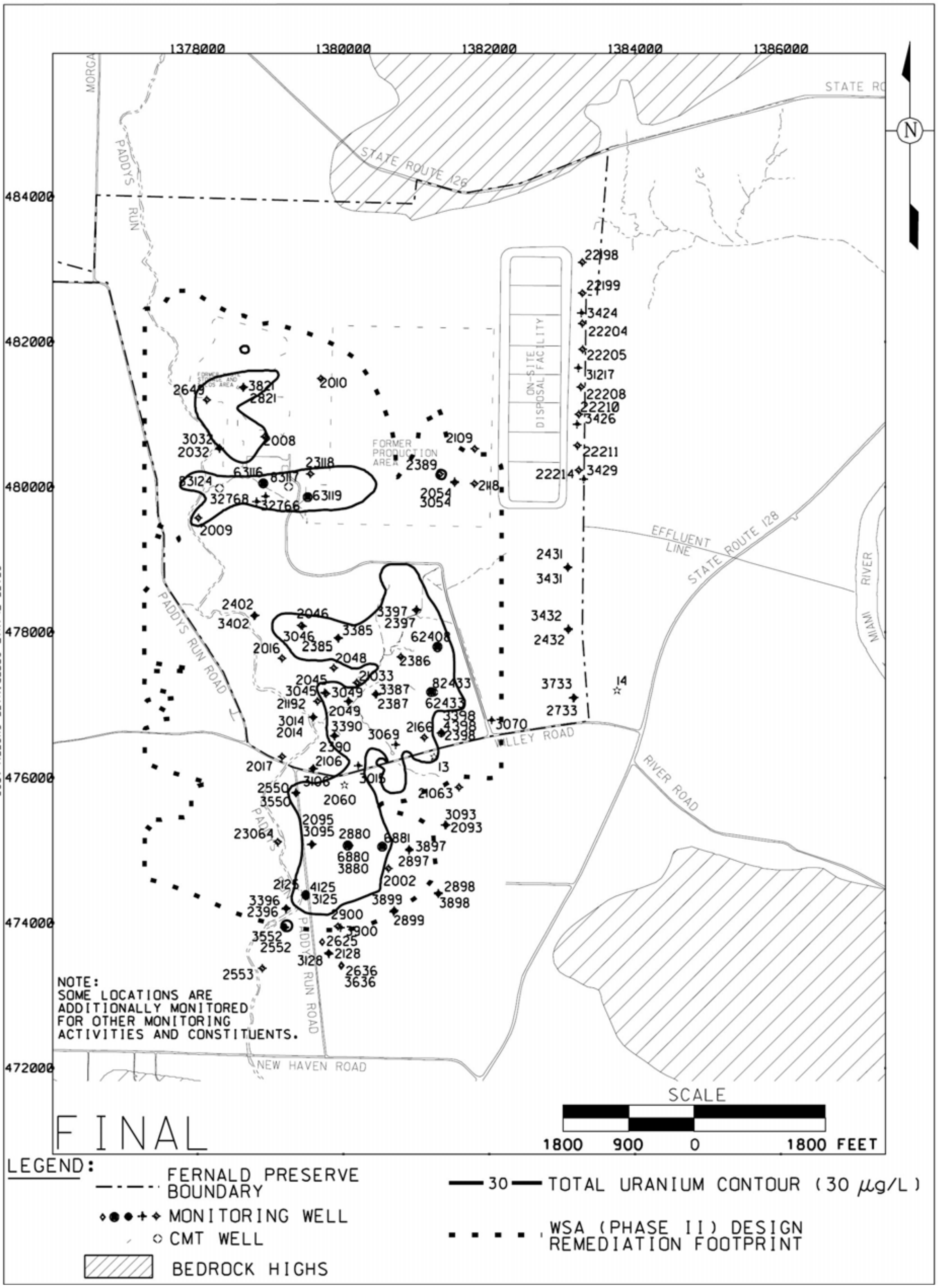

Figure A−18. Locations for Semiannual Total Uranium Monitoring

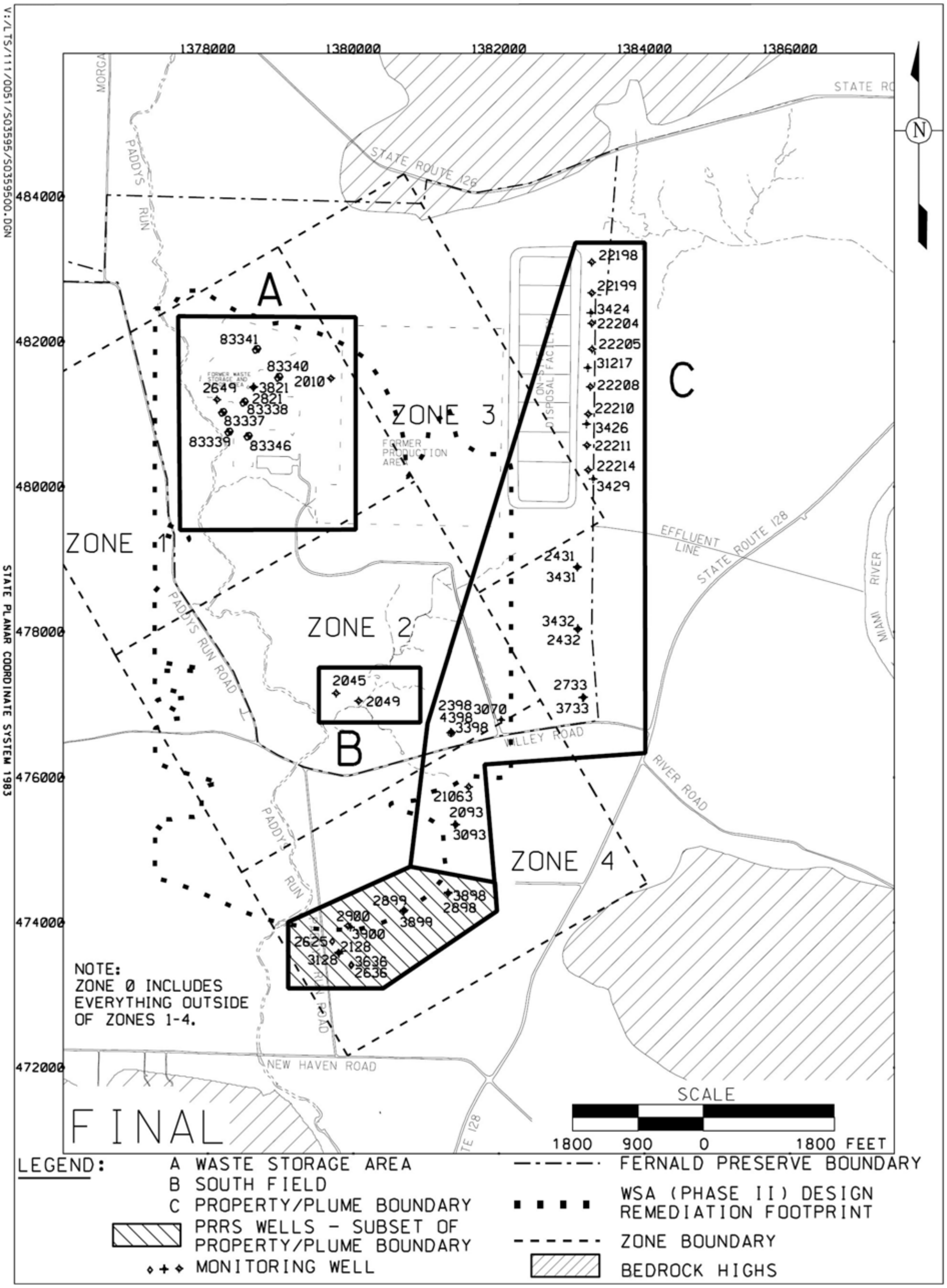

Figure A−19. Locations of Semiannual Monitoring for Property/Plume Boundary, South Field, and Waste Storage Area

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Appendix B

Surface Water Final Remediation Level Exceedances

Contents

Figures

Table

End of current text

1.0 Introduction

This appendix provides further information regarding the final remediation level (FRL) exceedances. As discussed in Section 4.4.2.3, a limited number of constituents have been detected above their respective FRLs at several surface water sample locations. To better quantify the actual number and location of exceedances, data collected under the IEMP (from August 1997 through December 2006) were compiled and compared to FRLs to determine the number and locations of the exceedances. Table B–1 itemizes the Fernald Site FRL exceedances based on IEMP characterization monitoring.

This appendix also provides figures that document the particular sample location where FRLs have been exceeded. Figures B–1 through B–10 show, by constituent, those locations with FRL exceedances. The figures also show FRL exceedances at background locations to document non-site exceedances; they also show exceedances from constituents previously monitored (i.e., constituents removed from monitoring as documented in IEMP, Revision 3, Appendix B; and IEMP, Revision 4, Appendix B) to provide a historical perspective.

Table B–1. Evaluation of Constituents Selected for IEMP Characterization Surface Water Monitoring Due to FRL Exceedances

Location	Currently Monitored COCs	Basis for Selection of Constituent Code[a, b]	No. of Analyses[c]	No. of FRL Exceedances[c]	Date of Last FRL Exceedance (No. of samples since exceedance)[c]
SWP-02 (Paddys Run)[d]	**Radionuclides:**				
	Technetium-99[e]	M	43	0	-
	Total Uranium[e,f]	PC	43	0	-
SWP-03[g] (Paddys Run at Downstream Property Boundary)	**Inorganics:**				
	Chromium, Total	S	43	5	11/12/2003 (13)
	Copper	S	43	2	9/27/2002 (18)
	Cyanide	M	33	0	-
	Mercury	M	41	1	04/13/1998 (35)
	Silver	M	42	0	-
	Zinc	M	36	0	-
	Radionuclides:				
	Radium-226	M	41	0	-
	Strontium-90	M	36	0	-
	Technetium-99	M	43	0	-
	Thorium-228[h]	WP	24	0	-
	Thorium-230[h]	WP	24	0	-
	Thorium-232[h]	WP	24	0	-
	Total Uranium[f]	PC, M	55	0	-
SWD-02 (Storm Sewer Outfall Ditch)	**Radionuclides:**				
	Strontium-90[e]	M	38	0	-
	Technetium-99[e,f]	M	39	0	-
	Total Uranium[f]	PC, M	71	0	-
SWD-03 (Waste Storage Area)	**Inorganics:**				
	Copper[e]	S	47	4	7/29/2006 (1)
	Cyanide[e]	M	36	0	-
	Mercury[e]	M	33	0	-
	Silver[e]	M	36	1	4/4/2000 (22)
	Zinc[e]	M	36	3	10/5/2002 (12)
	Radionuclides:				
	Technetium-99[e]	M	36	0	-
	Total Uranium[f]	PC	70	0	-
PF 4001 (Parshall Flume - Treated Effluent)	**Inorganics:**				
	Cadmium[i]	S	1024	2	12/19/2003 (421)
	Cyanide[i]	M	552	0	-
	Mercury[i]	M	117	0	-
	Silver[i]	M	1026	0	-
	Radionuclides:				
	Radium-226	M	44	0	-
	Strontium-90	M	38	0	-
	Technetium-99	M	118	0	-
	Total Uranium[f]	PC, M	3378	0	-

Table B–1. Evaluation for Constituents Selected for IEMP Characterization Surface Water Monitoring Due to FRL Exceedances (continued)

Location	Currently Monitored COCs	Basis for Selection of Constituent Code[a, b]	No. of Analyses[c]	No. of FRL Exceedances[c]	Date of Last FRL Exceedance (No. of samples since exceedance)[c]
STRM 4003	**Radionuclides:**				
(Drainage to Paddys Run)	Total Uranium[f]	PC, M, S	36	0	-
STRM 4004	**Radionuclides:**				
(Drainage to Paddys Run)	Total Uranium[f]	PC, M, S	29	0	-
STRM 4005	**Radionuclides:**				
(Drainage to Paddys Run)	Total Uranium[f]	PC, M, S	63	0	-
STRM 4006	**Radionuclides:**				
(Drainage to Paddys Run)	Total Uranium[f]	PC, M, S	36	0	-

Shading indicates location-specific constituents of concern. With the end of remediation and the fact that no FRL exceedances have occurred, this monitoring is no longer required.
[a]M = based on modeling; PC = primary constituent of concern; S = sporadic exceedances; WP = waste pits excavation monitoring
[b]Those constituents monitored based on Modeling (M) will continue to be monitored even if there has been no FRL/BTV exceedance.
[c]Based on analytical data from August 1997 through December 2006.
[d]With the removal of silos and excavation of the waste pits, this location is no longer needed.
[e]These location-specific constituents of concern were monitored during excavation. With the end of excavation and the fact that there has only been one nominal FRL exceedance, this monitoring was deemed to be no longer required starting with IEMP, Revision 5.
[f]Total uranium will continue to be monitored semiannually whether there is a basis or not (i.e., M, S, I) and the monitoring criteria will be identified as a Primary COC (PC). In addition, technetium-99 will continue to be monitored semiannually at Location SWD-02.
[g]Beryllium, cadmium, manganese, and radium-228 are being added to the program, but not to this table. This location is the last one surface water is monitored on Paddys Run prior to leaving the site; therefore, these constituents are being monitored at this location in order to be conservative.
[h]These constituents of concern were added during excavation of the waste pits. Even though waste pit excavation has ended, these constituents of concern were retained at this downstream property boundary location in order to be conservative.
[i]The COCs are monitored more frequently for NPDES and have been removed from IEMP Characterization.

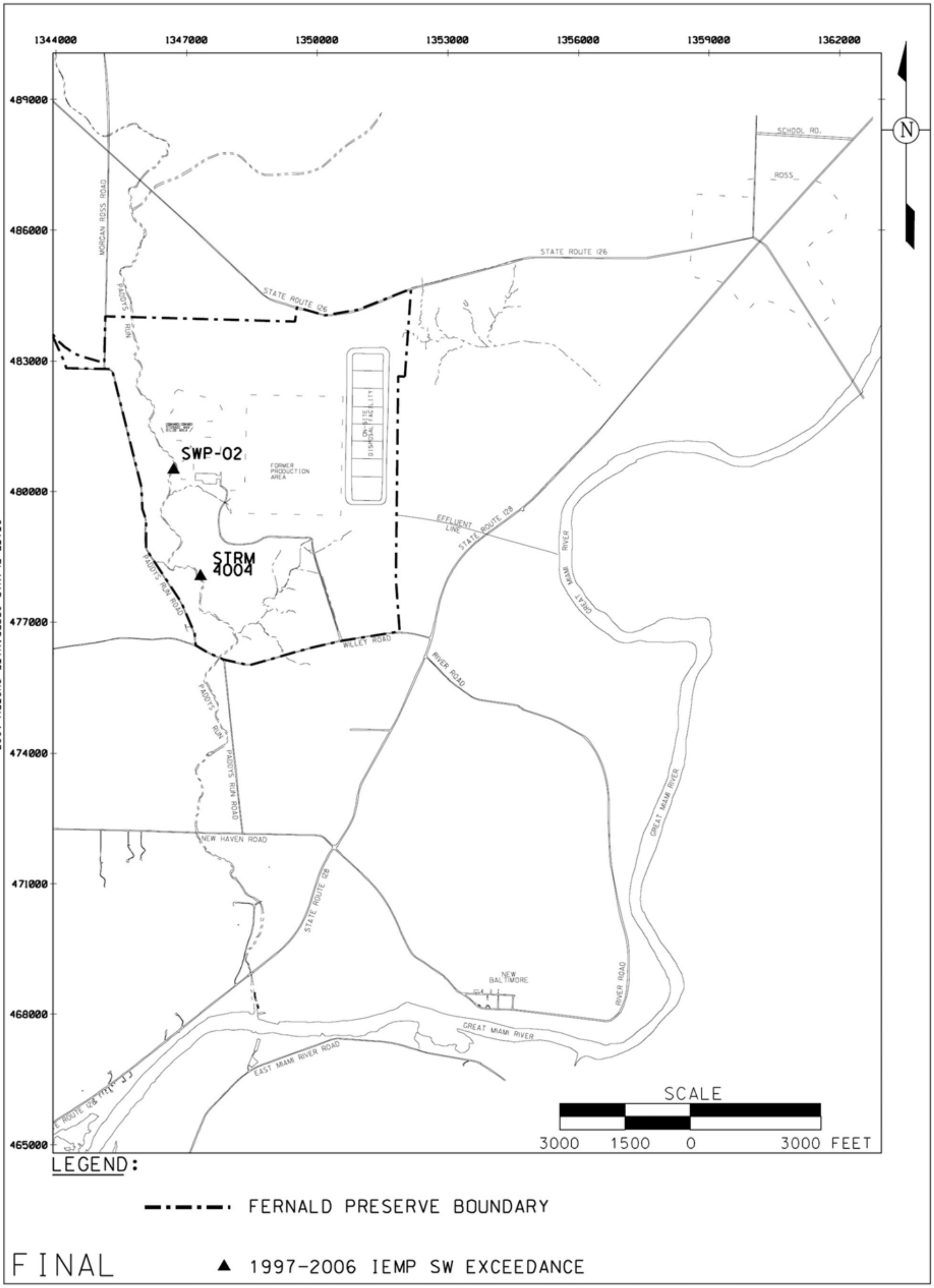

Figure B−1. Surface Water Locations with FRL Exceedances for Beryllium

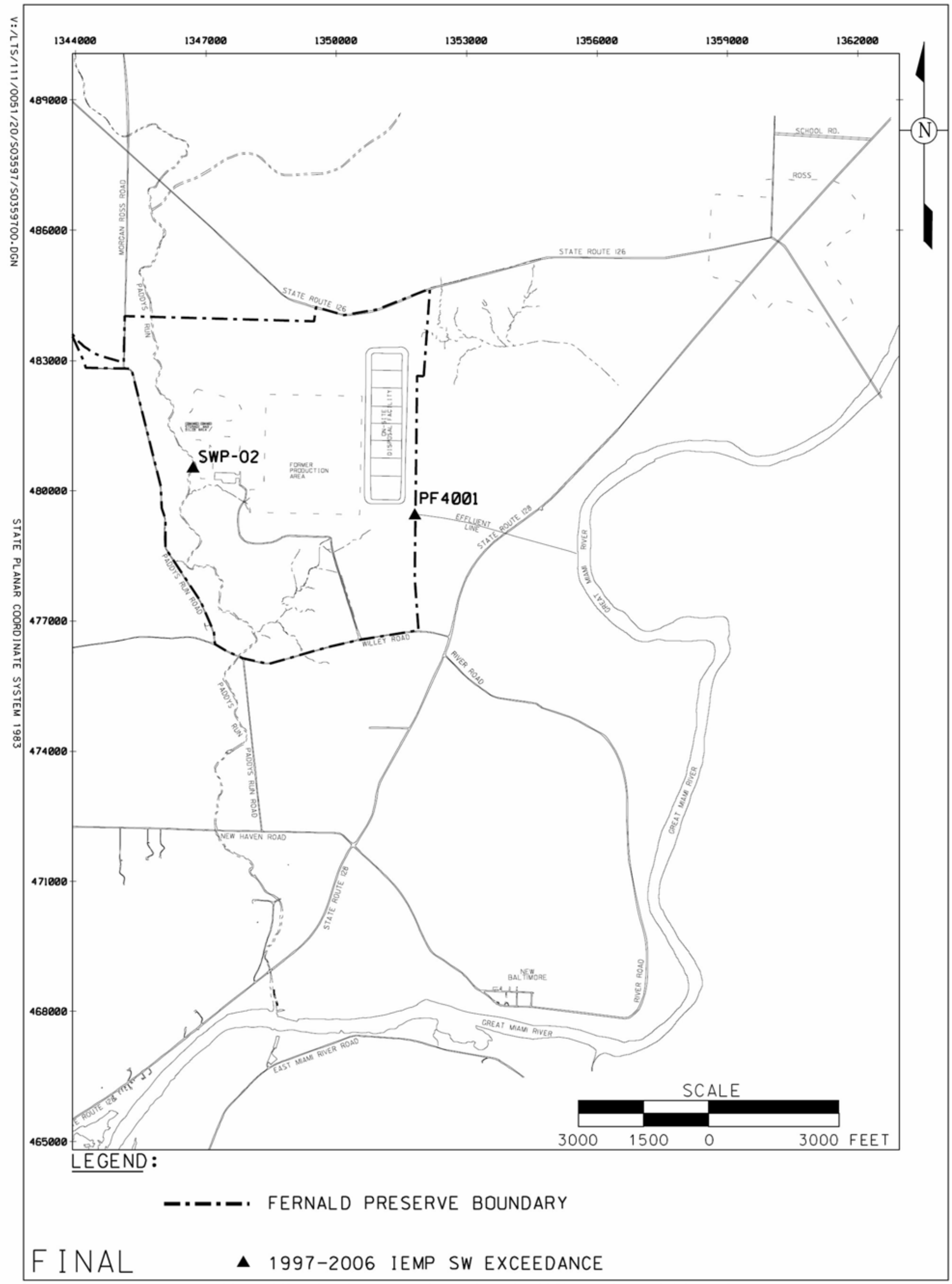

Figure B−2. Surface Water Locations with FRL Exceedances for Cadmium

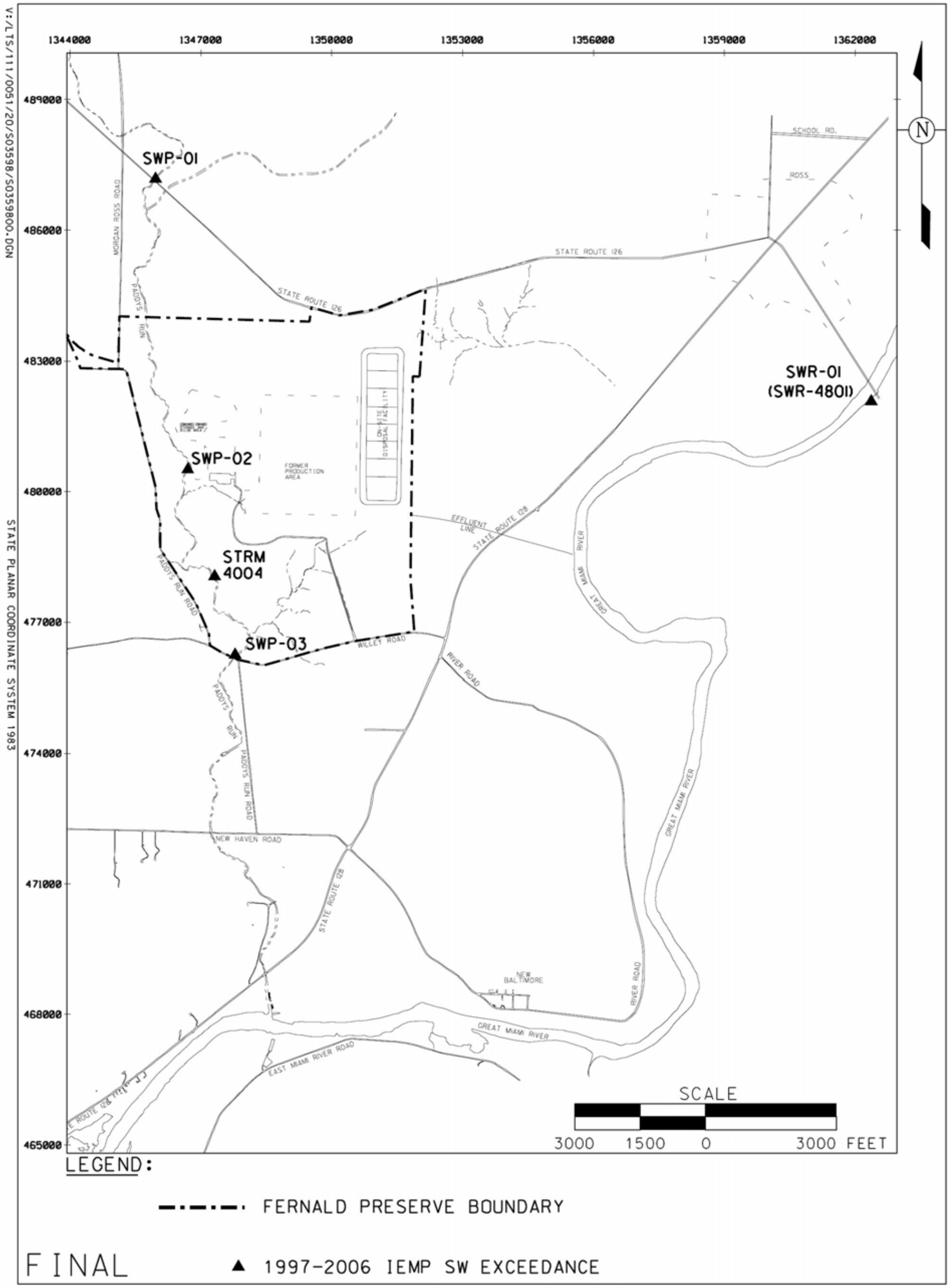

Figure B−3. Surface Water Locations with FRL Exceedances for Total Chromium

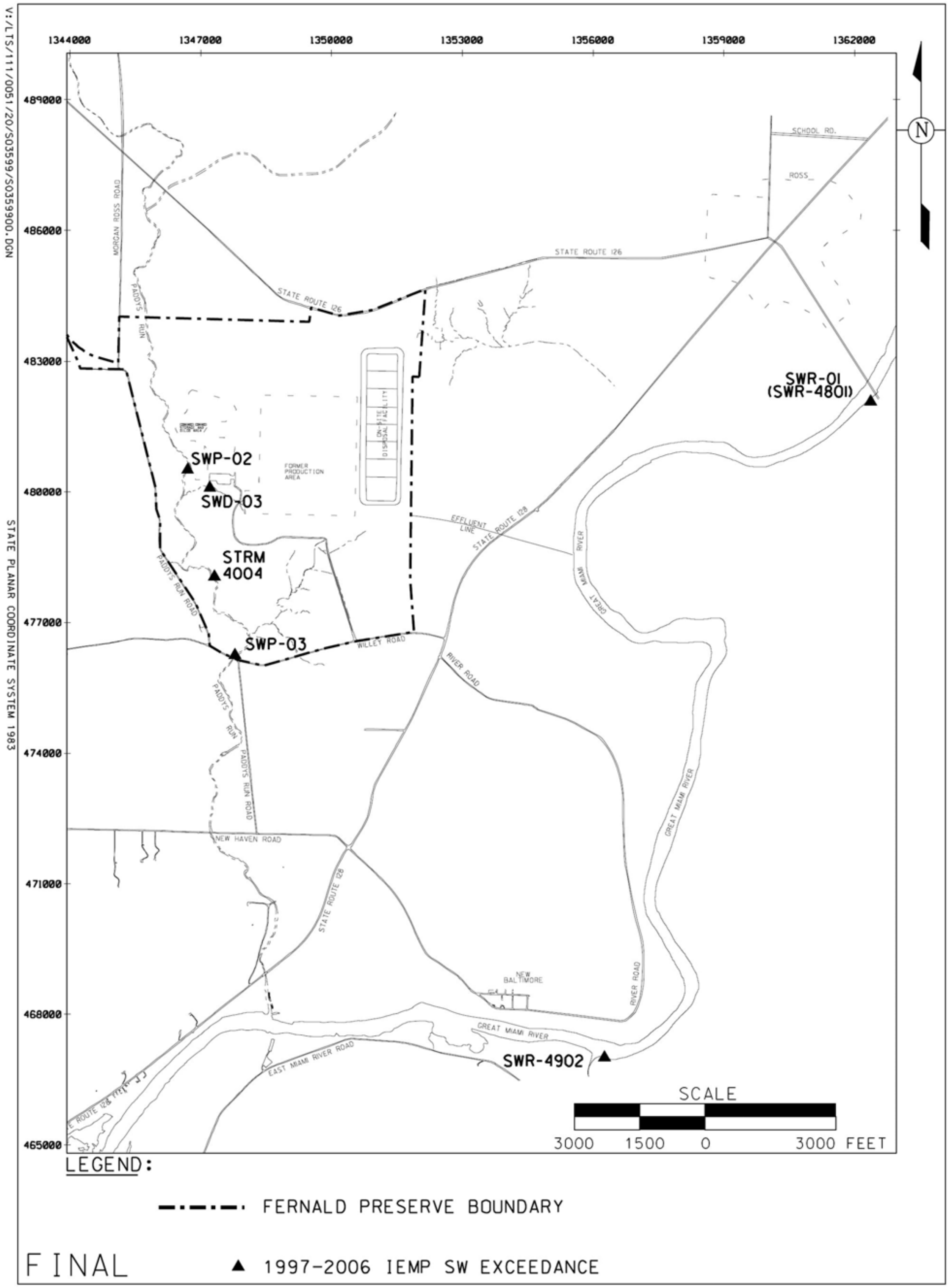

Figure B−4. Surface Water Locations with FRL Exceedances for Copper

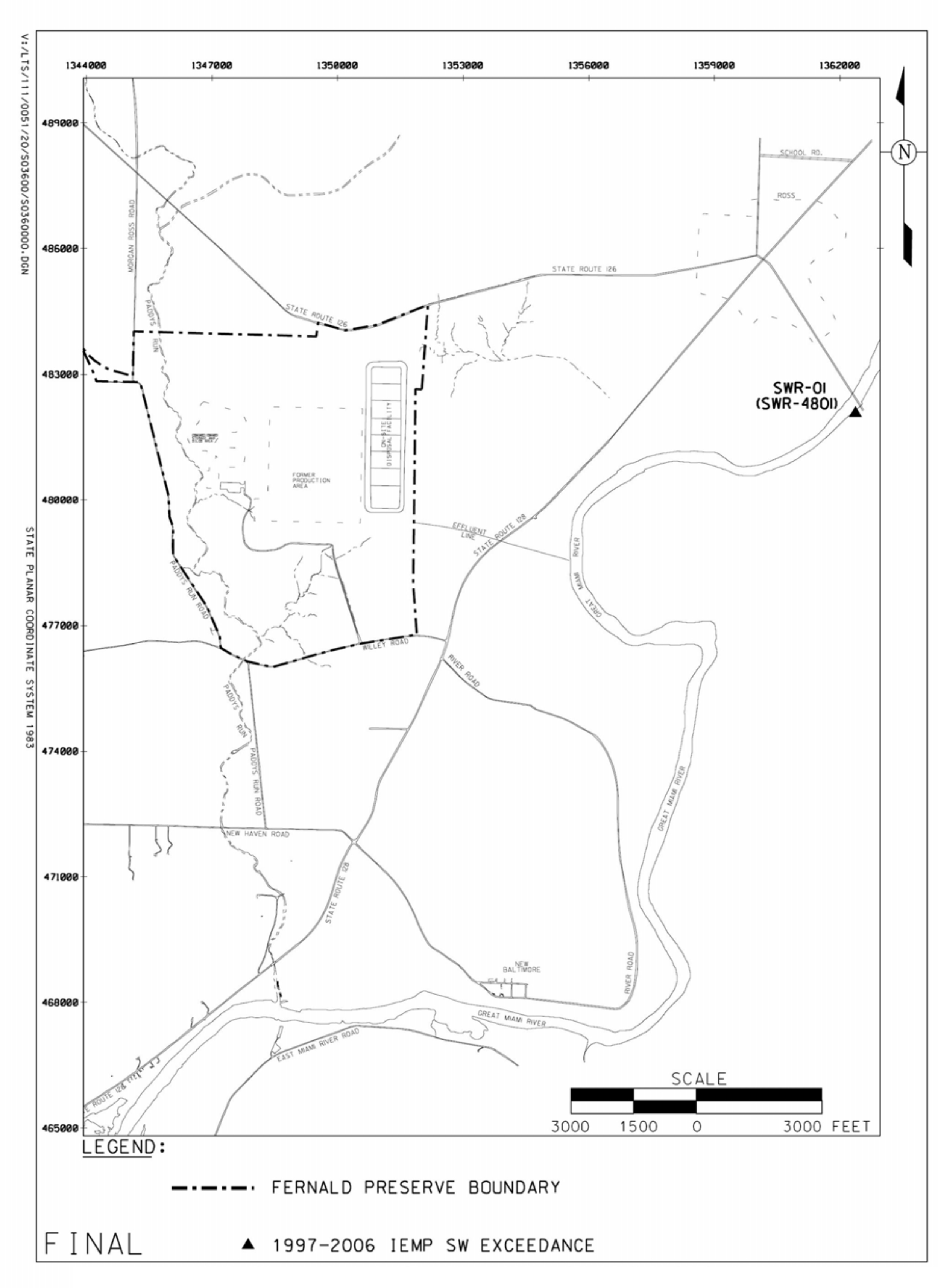

Figure B−5. Surface Water Locations with FRL Exceedances for Dibenzo(a,h) anthracene

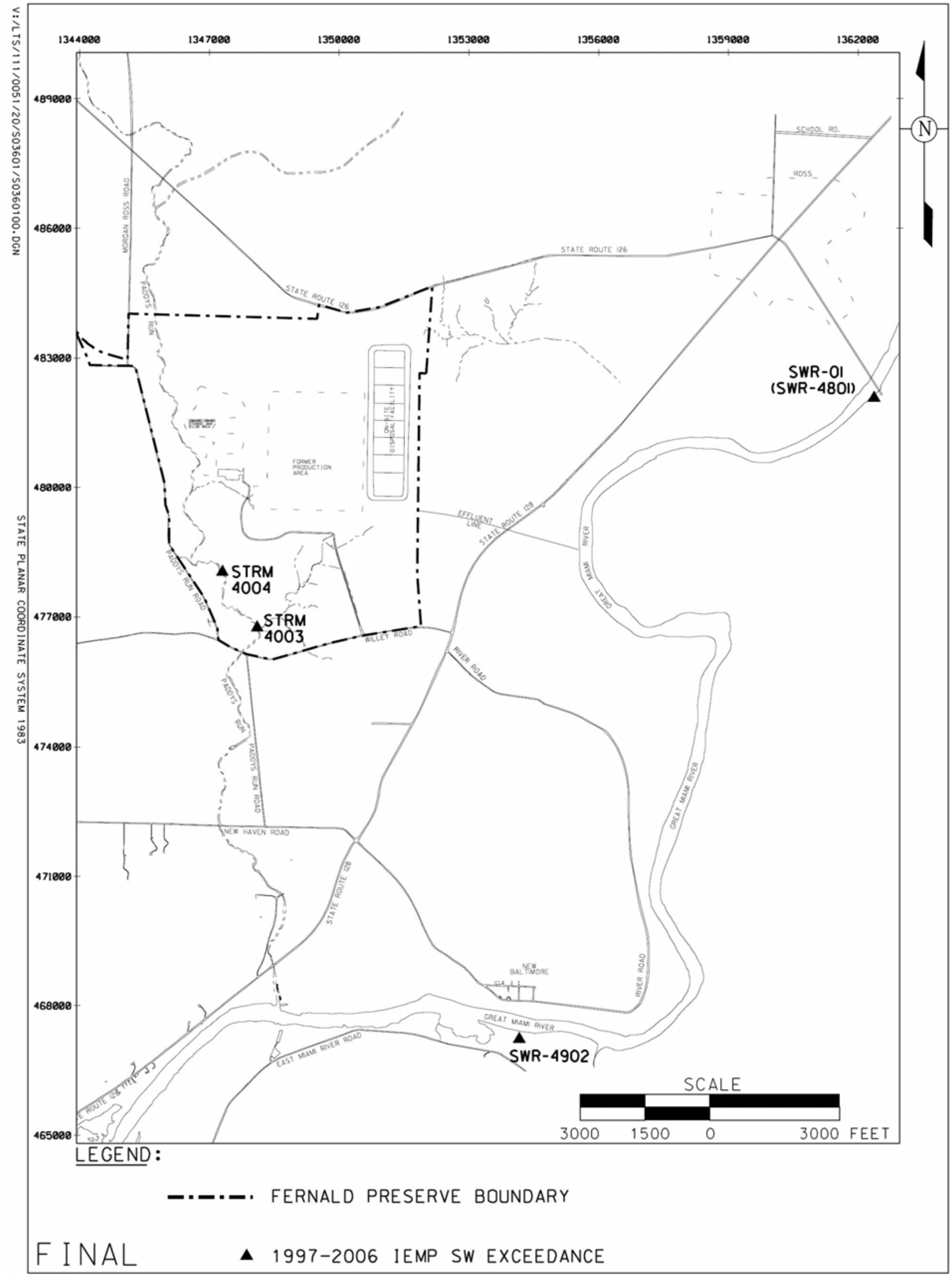

Figure B−6. Surface Water Locations with FRL Exceedances for Lead

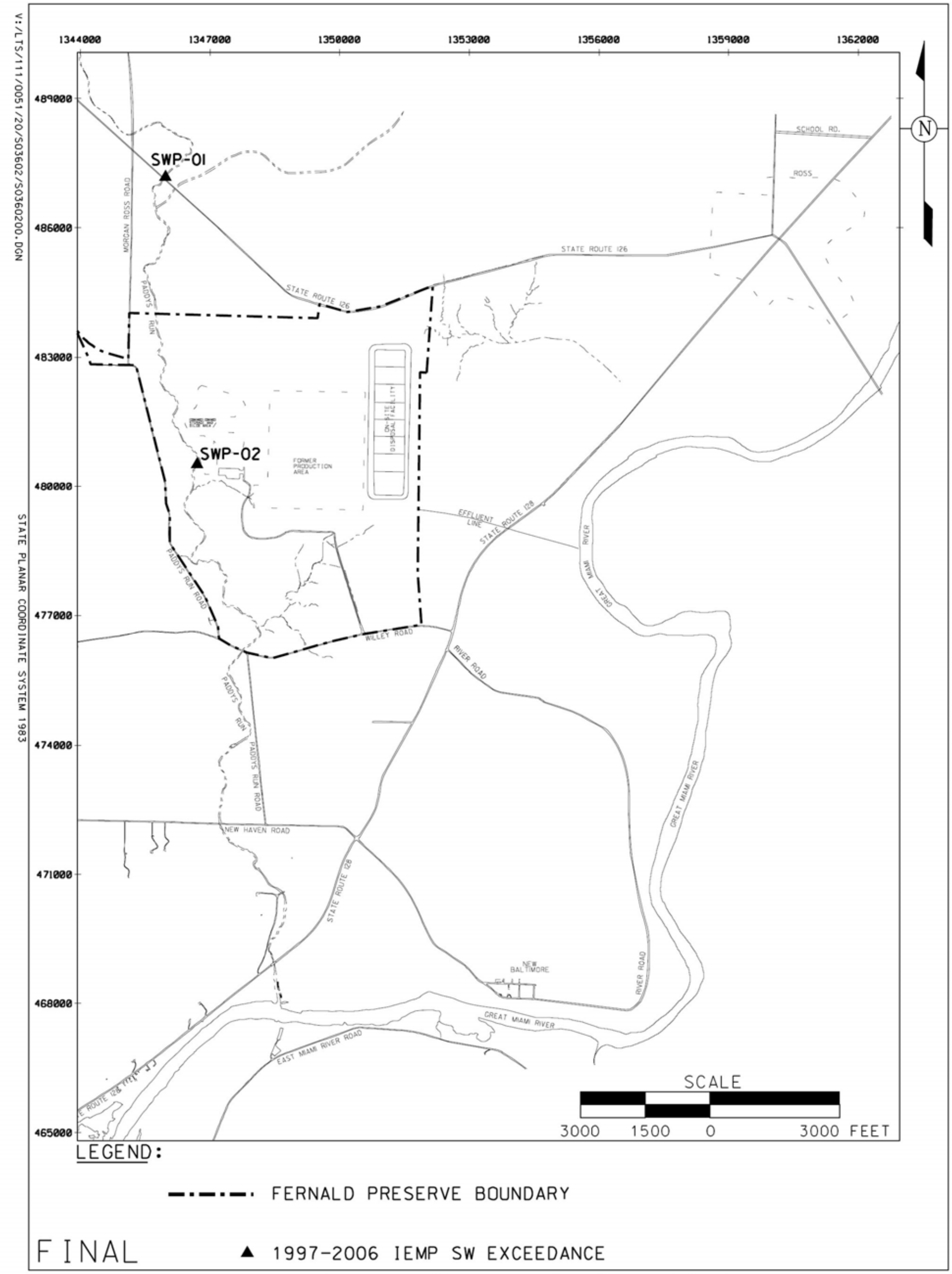

Figure B−7. Surface Water Locations with FRL Exceedances for Manganese

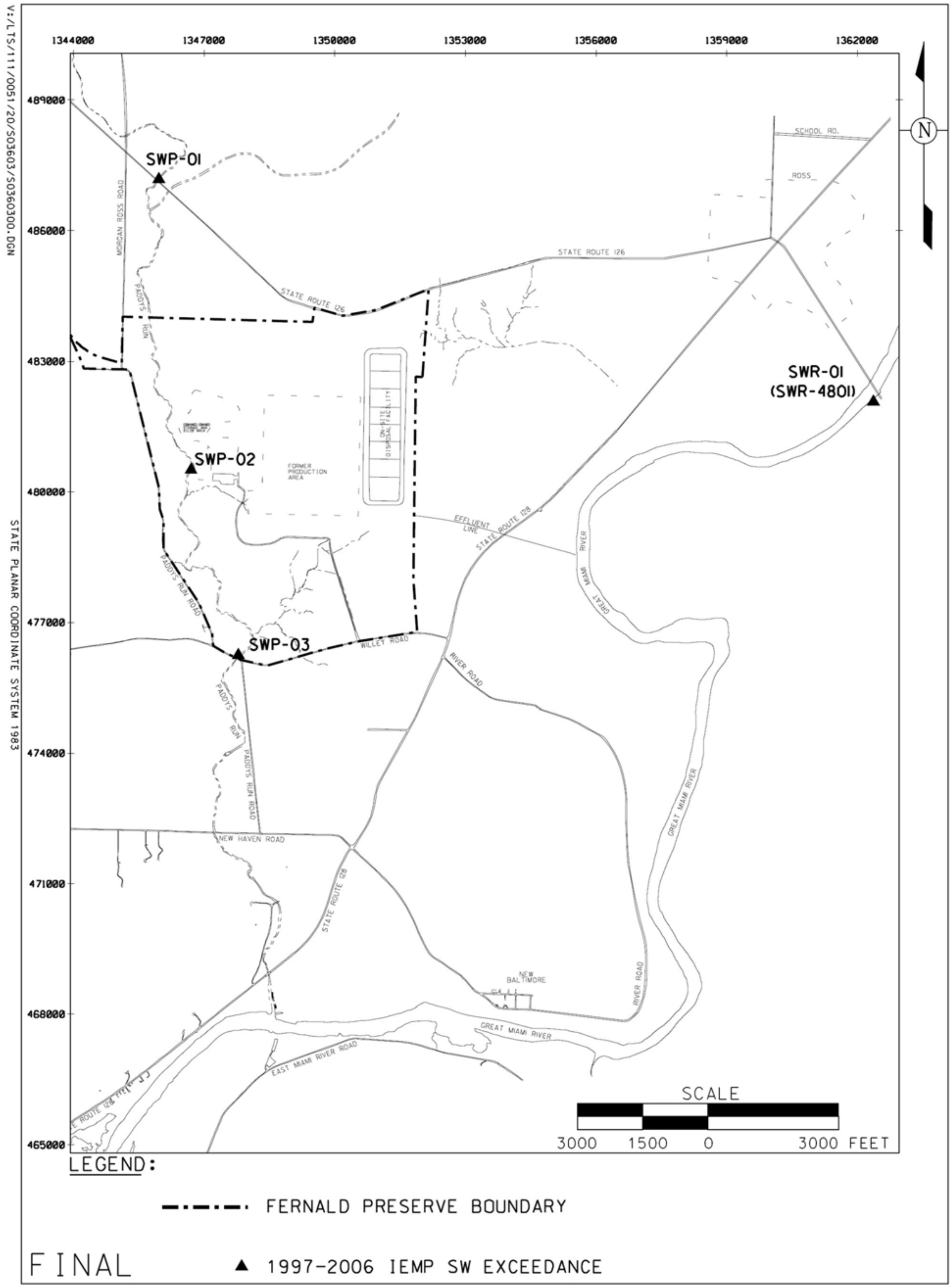

Figure B−8. Surface Water Locations with FRL Exceedances for Mercury

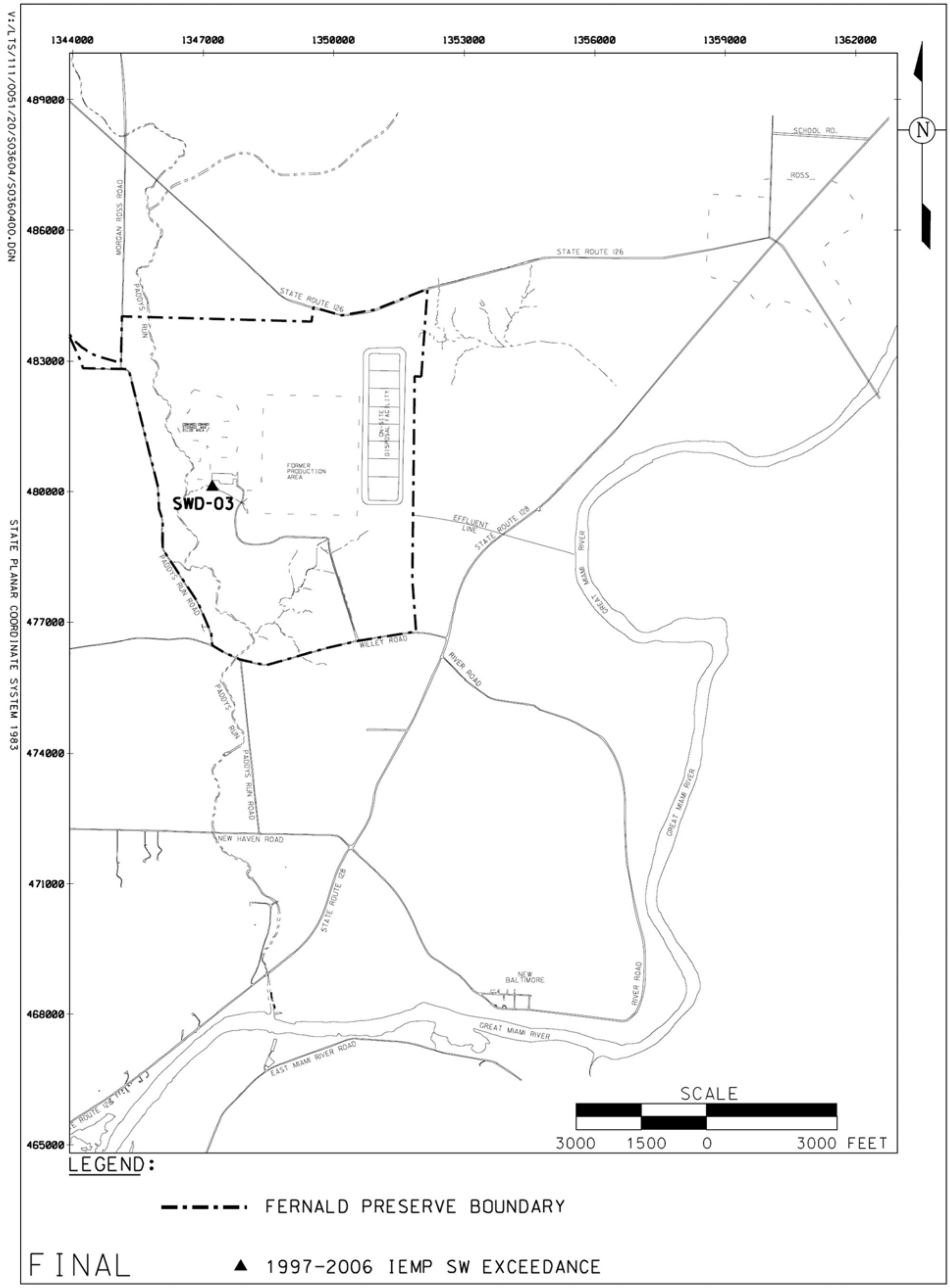

Figure B–9. Surface Water Locations with FRL Exceedances for Silver

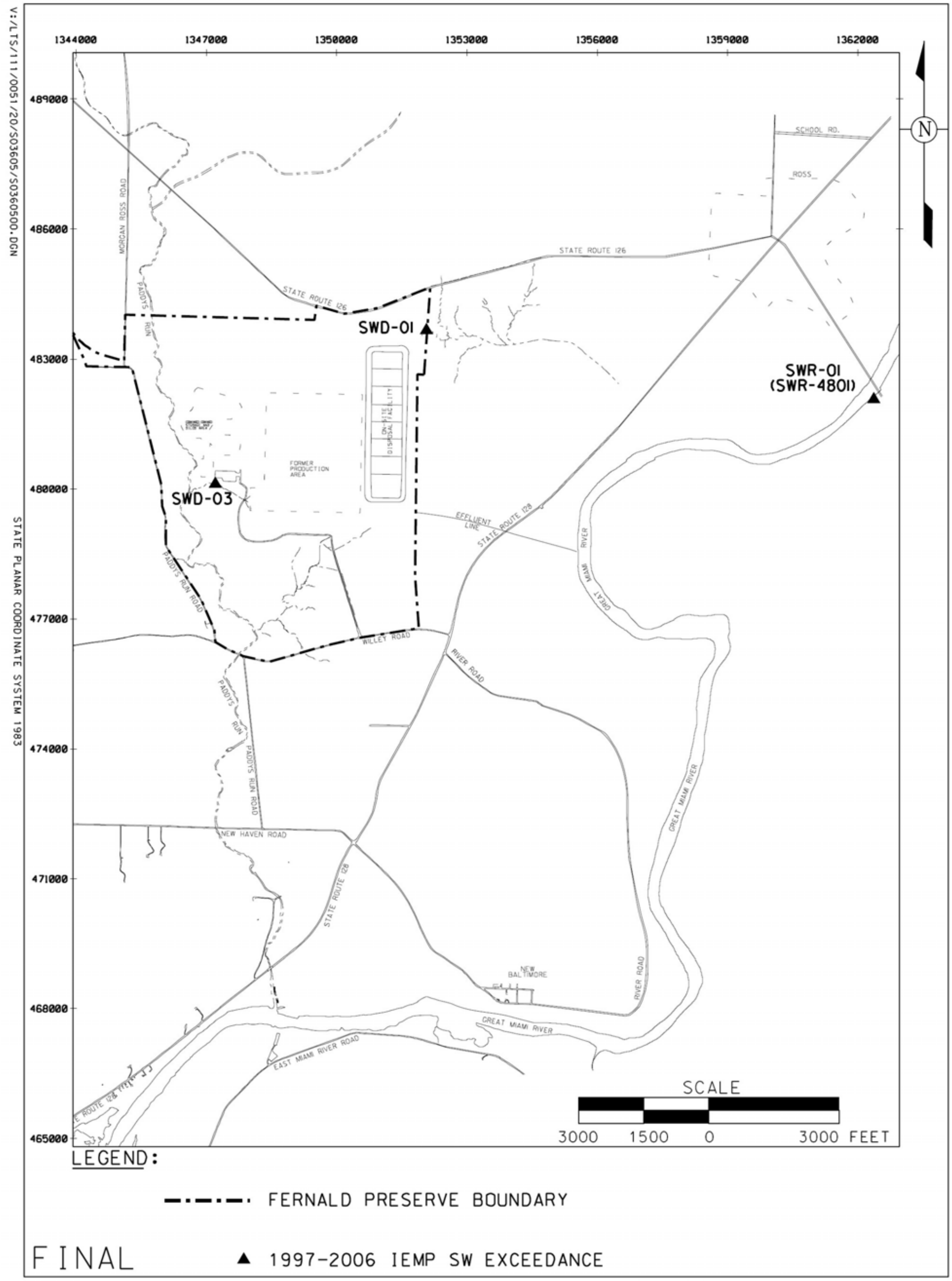

Figure B–10. Surface Water Locations with FRL Exceedances for Zinc

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Appendix C

Dose Assessment

Contents

Tables

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1.0 Introduction

This appendix describes the technical approach for conducting the annual radiological dose assessment. This approach will meet the intentions of U.S. Department of Energy (DOE) Order 5400.5 (DOE 1993) and the air pathway compliance determination (detailed in 40 *Code of Federal Regulations* [CFR] 61 National Emissions Standards for Hazardous Air Pollutants [NESHAP] Subpart H). The Integrated Environmental Monitoring Plan (IEMP) will be the mechanism for conducting and reporting the annual sitewide radiological dose assessments.

2.0 Background, Regulatory Drivers, and Requirements

Doses assessments have been prepared annually to confirm that radiological doses to the public from routine operations and emissions comply with the dose limits set by the U.S. Environmental Protection Agency (EPA) and DOE regulations and orders. Before 1998, yearly dose assessments of radiological air inhalation were based on computer modeling results generated with measured and estimated releases of airborne radioactive materials from significant sources. Since 1998, radiological dose assessments have been based on environmental monitoring results. This has resulted in more accurate estimates of doses attributable to fugitive emissions. Environmental monitoring results will continue to be collected from a limited number of monitors (five boundary monitors and one background monitor) until 2007. After 2007, upon approval from the EPA, dose assessments will be concluded.

This section describes radiological dose limits and guidelines as defined by various regulatory requirements including the applicable or relevant and appropriate requirements (ARARs), as they relate to dose assessments at the Fernald Preserve.

2.1 ARARs and Other Regulatory Drivers

This subsection summarizes the ARARs and other regulatory drivers for the dose assessment and associated dose limits. A site wide radiological dose assessment is needed to demonstrate compliance with the following limits and guidelines from DOE Order 5400.5 (DOE 1993), which incorporates dose assessment standards in 40 CFR 61 NESHAP, Subpart H:

The exposure of members of the public to radiation sources as a consequence of all routine activities at a DOE site shall not cause, in a year, an effective dose equivalent greater than 100 millirem (mrem). This annual effective dose equivalent is defined as the sum of direct external exposure for the year, plus the committed effective dose equivalent for intakes experienced during the year.

The guideline includes doses from remediation activities and naturally occurring radionuclides released by DOE processes, but not radon and its decay products. All pathways that could significantly contribute to the exposure are to be included in the calculations. Significant exposures are considered to be 1 percent (1 mrem) of the 100-mrem dose limit or greater.

Public exposure to radioactive materials released to the atmosphere as a consequence of all activities at a DOE site shall not cause, in a year, an effective dose equivalent greater than 10 mrem. Because this guideline implements the dose limits of 40 CFR 61 Subpart H, doses caused by radon-222 and its decay products are not included. The same annual effective dose equivalent definition applies as above.

The liquid effluents from DOE activities shall not cause private or public drinking water systems to exceed the drinking water radiological limits. These limits are defined 40 CFR 141, which says that effluents must not cause the drinking water radiological limits to exceed any of the following independent limits: man-made beta/gamma-emitting radionuclides at an annual average concentration that would cause an annual dose equivalent of 4 mrem to the total body or any internal organ; combined radium-226 and radium-228 at any time totaling 5 picocuries per liter (pCi/L); or gross alpha activity (including radium but excluding radon and uranium) of 15 pCi/L at any time.

The absorbed dose to native aquatic organisms shall not exceed one rad per day from exposure to the radioactive material in liquid wastes discharged to natural waterways. For the purposes of satisfying this requirement, the term "native aquatic organisms" (which is not otherwise defined by DOE) is interpreted to mean insects, macro-invertebrates, finned fish, and mammals.

3.0 General Technical Approach

This section presents a discussion of the general technical approach to be followed for performing the dose tracking and actual annual dose assessment. The discussion includes an explanation of exposure pathways and media important to the dose assessment, surveillance and characterization of these pathways, and the dose calculation procedure.

3.1 Medium-Specific Pathways

According to the past seven annual dose assessments and remedial investigation/feasibility studies at the Fernald Preserve, human receptors are potentially exposed through two medium-specific pathways: the air pathway, which includes inhalation and ingestion; and the direct radiation pathway. The air pathway may involve inhalation of contaminated fugitive dust. The direct radiation pathway includes exposure to contaminated soil and sediment and direct radiation from stored materials (e.g., K-65 silos). Note that the remediation activities associated with these pathways were completed in 2006.

3.1.1 Potential Receptors

Hypothetical receptors are usually selected to replicate the worst possible dose at locations with measured or calculated maximum air concentrations, even when there is no actual receptor at those locations. Thus, the NESHAP compliance demonstration is based on site boundary measurements although there are no actual receptors on the fence line. The IEMP focuses on measuring and ensuring levels at the site boundary are not exceeded, thereby ensuring the exposure levels to off-property residents are also below limits. As with previous dose assessments, exposure scenarios and parameters (e.g. duration of exposure and potential food sources) will generally be conservative.

3.1.2 Routine Surveillance of Pathways

Environmental media that have the potential to lead to a significant annual dose (greater than 1 percent of the DOE all-pathway combined dose limit of 100 mrem) at the Fernald Preserve boundary and representative receptor locations will be routinely sampled and analyzed for constituents contributing to the dose. Sections 3.0 through 6.0 of the main document describe medium-specific monitoring programs under the IEMP. Both the air and direct-exposure routes are monitored under the IEMP.

3.2 Dose Assessment Approach

3.2.1 Air Monitoring for NESHAP Subpart H Compliance

This section describes the technical approach for demonstrating compliance with NESHAP Subpart H using environmental measurements of radionuclide air concentrations at the Fernald Preserve boundary. It also addresses each of the criteria for environmental measurement compliance programs as described in 40 CFR 61.93 (b)(5) and the basic requirements issued by EPA for NESHAP Subpart H environmental measurements at the Fernald Preserve.

Criterion I: The air at the point of measurement shall be continuously sampled for collection of radionuclides.

The air monitoring stations sample air at approximately 1.3 cubic meters per minute (m^3/minute) using a 0.3 micron filter. The air monitoring stations contain a flow rate chart recorder and an hour meter to provide a record of the monitors operation over the sampling period. The air monitoring stations are routinely checked to ensure normal operation. Monitoring locations have been selected based on wind rose sectors and potential receptor locations.

Criterion II: Radionuclides released from the facility, which are the major contributors to the effective dose equivalent, must be collected and measured as part of the environmental measurement program.

The IEMP air-monitoring program consists of the following sampling and analytical regime:

Table C–1 identifies the analysis regime for samples collected from each air monitoring station.

Table C−1. Analysis Regime

Constituent	Frequency	Method	RL[a] (pCi/m^3)
Total Particulate	Monthly	Gravimetric	-
Total Uranium	Monthly	KPA	3E-05

[a]RL = Reporting Limit

Quarterly composite samples will be prepared from the monthly samples for each monitor. The composite samples will be analyzed at analytical support level E by an off-site laboratory for the following constituents of concern. Table C–2 provides the basis for the frequency of analysis and selection of constituents.

Table C−2. Quarterly Analysis Regime

Constituent	Method[a]	RL[b] (pCi/m^3)
Uranium-238	Alpha Spec.	9E-05
Uranium-234	Alpha Spec.	9E-05
Uranium-235/236	Alpha Spec.	9E-05
Thorium-228	Alpha Spec.	7E-06
Thorium-230	Alpha Spec.	7E-06
Thorium-232	Alpha Spec.	7E-06
Radium-226	Gamma Spec./Alpha Spec. Analysis	2E-04

[a]Or other EPA-approved methods
[b] RL=Reporting Limit, which provide adequate sensitivity to detect below 10 percent of the corresponding NESHAP standard for each radionuclide of interest

3.3 Frequency of Analysis

Quarterly analysis of composite samples is performed in order to meet the following needs of the IEMP air monitoring program:

- Confirmation that sufficient air sample volumes were collected to detect the low concentrations of contaminants in the air.
- Periodic confirmation that contaminant concentrations are below the levels that would cause a dose of 10 mrem/year.

Large volumes of air must be sampled from both the background and blank concentrations in order to readily detect and distinguish the presence of a contaminant at low concentrations. Because filter loading limits the volume of air that can be sampled with a single filter, quarterly composite sampling is used to create a sample that represents a large volume of air.

Quarterly measurements provide a means to check the concentrations of contaminants several times during the year. Activities or work practices will be adjusted if quarterly measurements indicate that the 10-mrem/year limit might be exceeded.

3.3.1 Basis for Quarterly Composite Analytical Suite

The isotopes selected for quarterly analysis represent the previous major contributors to dose based on the following considerations:

- Radionuclides that were stored in large quantities at the Fernald Site and were handled or processed during the remediation effort (uranium, thorium-232, thorium-230, and radium-226).
- Radionuclides that were the major contributors to dose based on recent environmental filter measurements (uranium, radium, and thorium-230).
- Radionuclides, which, due to their concentration in waste and contaminated soil, were major contributors to dose if the waste or soil is released in the form of fugitive dust (uranium, thorium-228, and thorium-230).

Note: DOE has monitored the changing mix of contributors by comparing the quarterly composite results to the NESHAP Appendix E, Table 2 values.

3.3.2 Consideration of Decay-Chain Daughter Products

Uranium-238, thorium-232, and uranium-235 are initial radionuclides in the uranium, thorium, and actinide decay chains, respectively. Table C–3 shows the decay chains and the half-lives of the daughter products.

Note: Doses caused by radon-222 and its decay products formed after the radon is released from the facility are not included in the NESHAP dose limit of 10 mrem/year and will not be measured as part of the NESHAP Subpart H compliance demonstration. A description of the Fernald Preserve radon monitoring program is included in Section 6.0.

Table C−3. Uranium, Thorium, and Actinide Decay Chains

Isotope	Half-Life	Isotope	Half-Life	Isotope	Half-Life
Uranium-238	4.5×10^{9} years	Thorium-232	1.4×10^{10} years	Uranium-235	7.1×10^{8} years
Thorium-234	24 days	Radium-228	5.7 years	Thorium-231	25.64 hours
Protactinium-234 (2 isomeric states)	1.2 minutes & 6.7 hours	Actinium-228	6.13 hours	Protactinium-231	3.25×10^{4} years
Uranium-234	2.5×10^{5} years	Thorium-228	1.9 years	Actinium-227	21.6 years
Thorium-230	8.0×10^{4} years	Radium-224	3.64 days	Thorium-227	18.2 days
Radium-226	1622 years	Radon-220	55 seconds	Francium-223	22 minutes
Radon-222	3.8 days	Polonium-216	0.16 second	Radium-223	11.4 days
Polonium-218	3.05 minutes	Lead-212	10.6 hours	Radon-219	4.0 seconds
Lead-214	26.8 minutes	Bismuth-212	60.5 minutes	Polonium-215	1.77×10^{-3} seconds
Bismuth-214	19.7 minutes	Polonium-212	3.04×10^{-7} seconds	Lead-211	36.1 minutes
Polonium-214	1.6×10^{-4} sec.	Lead-208	Stable	Bismuth-211	2.16 minutes
Thallium-210	1.3 minutes			Thallium-207	4.79 minutes
Lead-210	22 years			Lead-207	Stable
Bismuth-210	5 days				
Polonium-210	138 days				
Lead-206	Stable				

The majority of uranium and thorium received and processed during the production era of the Fernald Site had been separated from their decay chain daughters prior to shipment to the Fernald Site.

Radioactive decay laws govern the ingrowth of the daughters from the purified parent. Daughter product ingrowth is based on the length of time the parent-bearing material has been stored on site. As a general rule, the daughter of a long-lived parent (e.g., uranium-238, thorium-232, or uranium-235) grows into equilibrium with the parent in about 10 daughter half-lives. For example, using data from the table above, thorium-234 would reach equilibrium with uranium-238 in about 240 days (10 × 24 days).

Considering the half-lives in the table above and the 40-year production history of the Fernald Site, a number of the daughters (those with half-life greater than a few hours) can be considered present in equilibrium concentrations with their parents. These radionuclides (thorium-234, protactinium-234, radium-228, actinium-228, thorium-228, radium-224, and thorium-231) will be considered to be in equilibrium with their parent concentrations measured in the quarterly composite. The equilibrium-based concentration for these radionuclides will be compared to the corresponding 40 CFR 61 Subpart H, Appendix E, Table 2 value as described in Criterion IV. Other radionuclides (protactinium-231, actinium-227, and their decay products) have not had sufficient time to reach equilibrium with their parent. In fact, due to the 32,500-year half-life of protactinium-231, none of the decay chain daughters have had time for significant ingrowth. Therefore, concentrations of decay chain daughters in the uranium-235 chain below thorium-231 will be considered zero in the quarterly composite samples.

Criterion III: Radionuclide concentrations that would cause an effective dose equivalent of 10 percent of the standard shall be readily detectable and distinguishable from background.

As indicated in Table C-2, the reporting limits for the major contributors to dose are less than 10 percent of NESHAP Appendix E, Table 2 values and will be readily detectable if present. The analysis of samples from the background monitors will provide the data to distinguish fenceline and potential receptor monitoring results from background.

Criterion IV: Net measured radionuclide concentrations shall be compared to the concentration levels in Table 2 of Appendix E to determine compliance with the standard. In the case of multiple radionuclides being released from the facility, compliance shall be demonstrated if the value for all radionuclides is less than the concentration level in Table 2, and the sum of the fractions that result when each measured concentration value is divided by the value in Table 2 for each radionuclide is less than one.

Annual average radionuclide concentrations at each monitoring location will be determined for each radionuclide by dividing the sum of the radionuclide mass values, obtained via quarterly laboratory analysis, by the total volume of air drawn through the filter. As described above, decay chain daughter products will be assumed to be in equilibrium with the measured parent concentration. Concentrations will be corrected for background to obtain the net measured concentration. The resulting net annual average concentrations will be divided by the corresponding 40 CFR 61 Subpart H, Appendix E, Table 2 values. The resulting fractions will be summed per monitoring location to demonstrate compliance. Compliance with the Subpart H standard will be documented in a summary that will be submitted as part of the annual site environmental reports.

3.3.3 Managing Analytical Results

The analysis of environmental air samples may result in contaminant concentrations being reported at levels that are at or below the minimum detectable concentration (MDC). Contaminant concentrations, which are at or below MDC, are statistically indistinguishable from concentrations found in a blank sample. Air sample results that are reported at or below the MDC will, therefore, be considered non-detects (zero) for the purpose of demonstrating compliance with the NESHAP dose limit.

Detectable contaminant concentrations will be corrected to net detectable concentrations using the background concentration measured during the same sampling period. Background air monitoring results that are at or below MDCs will not be used.

Criterion V: A quality assurance program shall be conducted that meets the performance requirements described in Appendix B, Method 114.

All environmental sample collection and analysis conducted in support of the remediation effort at the Fernald Preserve are subject to the quality assurance requirements of the Legacy Management CERCLA Sites Quality Assurance Project Plan (LM QAPP) (DOE 2006a).

Criterion VI: Use of environmental measurements to demonstrate compliance with the standard is subject to prior approval by EPA. Applications for approval shall include a detailed description of the sampling and analytical methodology and show how the above criteria will be met.

The IEMP and its appendices provide a description of the sampling and analytical methodology and explain how the criteria will be met. DOE submitted an application to use environmental measurements to demonstrate compliance with the NESHAP Subpart H standard to EPA in May 1997. EPA approved the application in August 1997.

3.4 All-Pathway Dose Calculations

This section describes the technical approach for demonstrating compliance with the 100-mrem/year, all-pathway dose limit in DOE Order 5400.5 (DOE 1993). Estimates of annual dose are based on the measured, background-corrected concentration of a contaminant in each environmental medium.

The general form of the dose assessment equation is:

$$D = C_{\mathbf{i,m}} * I_{\mathbf{m}} * DCF_{\mathbf{i}}$$

where:

D = Dose (mrem/year)

$C_{i,m}$ = Background-corrected concentration of radionuclide "i" in medium "m" (pCi/kg or pCi/L)

I_m = Intake (ingestion) rate for medium (kg/year)

DCF_i = Dose conversion factor for radionuclide "i" (mrem/year*pCi)

The detailed calculation of doses from the various environmental media is governed by OLM SAP (DOE 2006b). Doses from all the media monitored under the IEMP also will be calculated according to relevant sections in this procedure. In general, air inhalation dose and direct radiation dose will be separately calculated and then combined into the DOE all-pathway annual dose.

4.0 Reporting

Based on the objective of the dose assessment described in Section 1, there will be two interfacing and reporting mechanisms in which the dose assessment results will be presented. Each of these two reporting processes is described in the following subsections.

4.1 Regulatory Interfaces

The IEMP air monitoring data will be posted to the Geospaticial Environmental Mapping System (GEMS). When the monitoring data indicate a need for adjusting or implementing project-specific source control measures, the regulatory agencies will be notified by the specific remediation projects. The modifications and the effectiveness of the improved source control measures will also be documented.

4.2 Annual Reporting

The NESHAP Subpart H Annual Report will be issued as part of the annual site environmental report, according to reporting schedule in Section 7.0 of the IEMP. Annual summaries of the monitoring results, calculated doses from airborne emissions and calculated direct radiation dose will be included in the report. Comparisons of the pathway-specific doses and the combined annual radiological doses to the regulatory dose limits will also be presented.

5.0 Summary

Table C–4 further summarizes the responsibilities of the IEMP to fully implement the sitewide air-pathway dose tracking and annual dose assessment processes.

Table C−4. Sitewide Dose Tracking and Annual Assessment Tasks

Tasks	IEMP
• Annual Sitewide Planning	Evaluate planned activities and conditions at beginning of the year
• Routine Site boundary Monitoring	Conduct routine air monitoring at background and site boundary locations
• Preventive Tracking/Feedback	Directly compare routine monitoring results to annual dose benchmarks; report and evaluate any exceedances
• NESHAP Compliance Demonstration	Based on actual monitoring data, calculate annual doses at monitoring locations.
• Reporting	Prepare summaries and the annual NESHAP report

6.0 References

DOE (U.S. Department of Energy), 1993. *Radiation Protection of the Public and the Environment,* DOE Order 5400.5, Change 2, U.S. Department of Energy, Washington, DC, January 7.

DOE (U.S. Department of Energy), 2006a. *Legacy Management CERCLA Sites Quality Assurance Project Plan*, DOE-LM/GJ1189-2006, S.M. Stoller Corporation, Grand Junction, Colorado, June.

DOE (U.S. Department of Energy), 2006b. *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites*, DOE-LM/GJ1197-2006, Revision 0, S.M. Stoller Corporation, Grand Junction, Colorado, May.

Appendix D

Natural Resource Monitoring Plan

Contents

Figures

Table

End of current text

1.0 Introduction and Objectives

The purpose of the Natural Resource Monitoring Plan (NRMP) is to outline a comprehensive plan for monitoring natural resources at the Fernald Preserve. Monitoring requirements related to natural resources include the following: (1) monitoring the status of several priority natural resource areas to maintain compliance with applicable regulations; (2) monitoring of completed restoration projects as specified in Natural Resource Restoration Design Plans (NRRDP); and (3) monitoring impacts to natural resources from site activities. The results of this monitoring will be used to inform the U.S. Environmental Protection Agency (EPA), Ohio Environmental Protection Agency (OEPA), and the Fernald Natural Resource Trustees of the status of natural resources at the Fernald Preserve. Monitoring results will be reported in the annual site environmental reports.

2.0 Analysis of Regulatory Drivers

As shown in Table D–1, regulatory drivers for the management of natural resources and associated impact monitoring include six areas: endangered species protection; wetlands/floodplain regulations; cultural resource management; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) natural resource trusteeship process; the National Environmental Policy Act (NEPA); and the NRRDPs.

2.1 Threatened and Endangered Species

The federal laws and regulations listed below mandate that any action authorized, funded, or carried out by the U.S. Department of Energy (DOE) cannot jeopardize the continued existence of any threatened or endangered (i.e., listed) species or result in the destruction or adverse modification of the constituent elements essential to the conservation of a listed species within a defined critical habitat. Additional requirements may apply if it is determined that a proposed activity could adversely affect these species or their habitat. These laws and regulations include the Endangered Species Act (16 United States Code [U.S.C.] §1531, et seq.) and its associated regulations (50 *Code of Federal Regulations* [CFR] 17 and 50 CFR 402).

State law also protects endangered species by prohibiting the taking or destruction of any state-listed endangered species. These laws are found in Ohio Revised Code §1518 and §1531, as well as in Ohio Administrative Code §1501.

2.2 Wetlands/Floodplains

Executive Order 11990 (Protection of Wetlands) and Executive Order 11988 (Protection of Floodplains), which are implemented by DOE Regulation 10 CFR 1022, "Compliance with Floodplain/Wetlands Environmental Review Requirements," specify the requirement for a Floodplain/Wetland Assessment in cases where DOE is responsible for providing federally undertaken, financed, or assisted construction and improvements that may impact floodplains or wetlands. This regulation further requires that DOE exercise leadership to minimize the destruction, loss, or degradation of wetlands; and preserve and enhance the natural and beneficial values of wetlands.

Table D−1. Fernald Site Natural Resource Monitoring

DRIVER	ACTION
Endangered Species Act Ohio Endangered Species Regulations	The IEMP describes management of existing habitat and follow-up surveys.
Clean Water Act — Section 404	The IEMP describes the monitoring of mitigated wetlands.
National Historic Preservation Act Native American Graves Protection and Repatriation Act Archaeological Resources Protection Act	The IEMP describes the monitoring of cultural resources.
CERCLA Executive Order 12580 National Contingency Plan	The IEMP describes the CERCLA Natural Resources Trusteeship process.
NEPA	The IEMP discusses the substantive requirements of NEPA for protecting sensitive environmental resources.
Project-specific NRRDPs	The IEMP discusses restored area monitoring.

Pursuant to Section 404 of the Clean Water Act and 33 CFR § 323.3, any activity that results in the discharge of dredged or fill material out of or into a wetland or water of the United States requires permit authorization by the Army Corps of Engineers. These permits can be in the form of either nationwide permits (33 CFR Part 330) or individual permits (33 CFR Part 323) depending on the nature of the activity.

Section 401 of the Clean Water Act and 33 CFR §325.2(b)(1)(ii) also require that a Section 401 State Water Quality Certification be obtained to authorize discharges of dredged and fill material under a Section 401 permit. In Ohio, the Section 401 State Water Quality Certification program is administered by OEPA pursuant to Chapter 3745-32 of the Ohio Administrative Code.

2.3 Cultural Resource Management

Management of cultural resources, particularly archeological sites, is mandated by the National Historic Preservation Act (16 United States Code [U.S.C.] §470), the Native American Graves Protection and Repatriation Act (25 U.S.C. 3001, et seq.), and the Archeological Resources Protection Act (16 U.S.C. §470aa-470ll). The associated regulations for the above laws are found in 36 CFR 800, 43 CFR 10, and 43 CFR 7, respectively. These laws and regulations ensure that archeological resources on federal land are appropriately managed. Section 106 of the National Historic Preservation Act ensures that DOE takes into consideration the effect of its undertakings on properties eligible for listing on the National Register of Historic Places. The Native American Graves Protection and Repatriation Act and 43 CFR 10 require that the rightful control of Native American cultural items discovered on federal land be relinquished to the appropriate, culturally affiliated tribe. Federal land is defined as “land that is owned or controlled by a federal agency.” Cultural items are defined as “human remains, associated funerary objects, unassociated funerary objects, sacred objects, and objects of cultural patrimony.” The Archeological Resources Protection Act and 43 CFR 7 ensure that competent individuals carry out archeological excavations in a scientific manner.

DOE signed a Programmatic Agreement with the Advisory Council on Historic Preservation and the Ohio Historic Preservation Office that streamlines the National Historic Preservation Act, Section 106 consultation process. Monitoring provisions will be included as part of this agreement to ensure that appropriate management is implemented for any eligible properties at the Fernald Preserve.

2.4 The CERCLA Natural Resource Trusteeship Process

CERCLA, Executive Order 12580, and the National Contingency Plan collectively require certain federal and state officials to act on behalf of the public as trustees for natural resources. Natural Resource Trustees for the Fernald Preserve are the Secretary of DOE; the Secretary of the U.S. Department of the Interior; and officials of the OEPA, appointed by the governor of Ohio.

The role of the Natural Resource Trustees is to act as guardians for public natural resources at or near the Fernald Preserve. The trustees are responsible for determining if natural resources have been injured as a result of a release of a hazardous substance or oil spill from the site, and if so, how to restore, replace, or acquire the equivalent natural resources to compensate for the injury. As the responsible party, DOE is potentially liable for costs related to natural resource injury.

The Fernald Natural Resource Trustees began meeting in June 1994to evaluate and determine the feasibility of integrating the trustees' concerns with site remediation activities. The trustees identified their desire to resolve DOE's liability by integrating restoration activities with the Fernald Site's remediation.

The Fernald Natural Resource Trustees chose to focus on a restoration-based approach to resolve DOE's liability for natural resource impacts. To accomplish this, the trustees signed a Memorandum of Understanding that established implementation of a Natural Resource Restoration Plan (NRRP) as the primary means of settlement for an existing natural resource damage claim by OEPA against DOE. The NRRP set forth a conceptual design for a series of ecological restoration projects that encompasses approximately 904 acres of the Fernald Site. Detailed designs were generated through NRRDPs written for each restoration project. Results of NRMP monitoring were taken into consideration during the design of these area-specific restoration projects. NRRDPs have project-specific monitoring requirements to determine the success of the restoration project. As stated in Section D.1, this monitoring will be summarized in the site environmental reports. Detailed results of restoration monitoring will be provided annually in the appendix to the site environmental report.

2.5 National Environmental Policy Act

In addition to the regulatory drivers summarized above, aspects of natural resource management and monitoring are mandated through the incorporation of substantive NEPA requirements into remedial action planning. In June 1994, DOE issued a revised secretarial policy on NEPA compliance. This policy called for the integration of NEPA requirements into the CERCLA decision-making process. Therefore, requirements for the protection of sensitive environmental resources including threatened and endangered species and cultural resources are to be considered throughout legacy management activities.

2.6 Natural Resource Restoration Design Plans

NRRDPs were written for each ecological restoration project completed on site. The design documents were submitted to EPA and the Fernald Natural Resource Trustees prior to the commencement of restoration activities in a given area. In addition to describing the restoration activities, they also outline the monitoring requirements for each project area once restoration activities were completed. Following is a list of the NRRDPs that are associated with the areas that require monitoring following closure of the site (i.e., physical completion was declared on October 29, 2006).

- Wetland Mitigation Project (Phase II) NRRDP (Area 6, Phase I).
- Borrow Area NRRDP Wetland Mitigation (Phase III).
- Area 8, Phase III NRRDP (Paddys Run West).
- Paddys Run East NRRDP.
- Silos NRRDP.
- Former Production Area NRRDP.
- Waste Pits Area and Paddys Run NRRDP.

3.0 Program Expectations and Design Considerations

The expectations of the monitoring and reporting as outlined in the NRMP are as follows:

- Provide a mechanism to monitor the status of the Fernald Site's natural resources to remain in compliance with applicable laws and regulations.
- Monitor restored areas to ensure requirements of the NRRDPs are being met and restored areas continue to develop and function as designed.

The results of the monitoring outlined in this NRMP will be compiled and reported to EPA and OEPA. Results will be reviewed to ensure that ecologically restored areas are performing as designed. In the event that results indicate that a restored area is not functioning as intended, decisions will need to be made by the DOE Office of Legacy Management (DOE-LM) in consultation with EPA, OEPA, and Natural Resource Trustees regarding appropriate corrective actions.

4.0 Natural Resource Monitoring Plan

Monitoring was implemented during remediation activities to identify impacts to natural resources at the Fernald Site with particular emphasis placed on meeting regulatory requirements for NEPA, threatened and endangered species, wetlands/floodplains, and cultural resources. To accommodate natural resource monitoring, priority natural resource areas have been established across the Fernald Preserve (Figure D–1). Fernald Site personnel conducted all natural resource monitoring during remediation, with oversight from the DOE Office of Environmental Management (DOE-EM). Monitoring has and will continue during legacy management (post-closure), but will be carried out under DOE-LM.

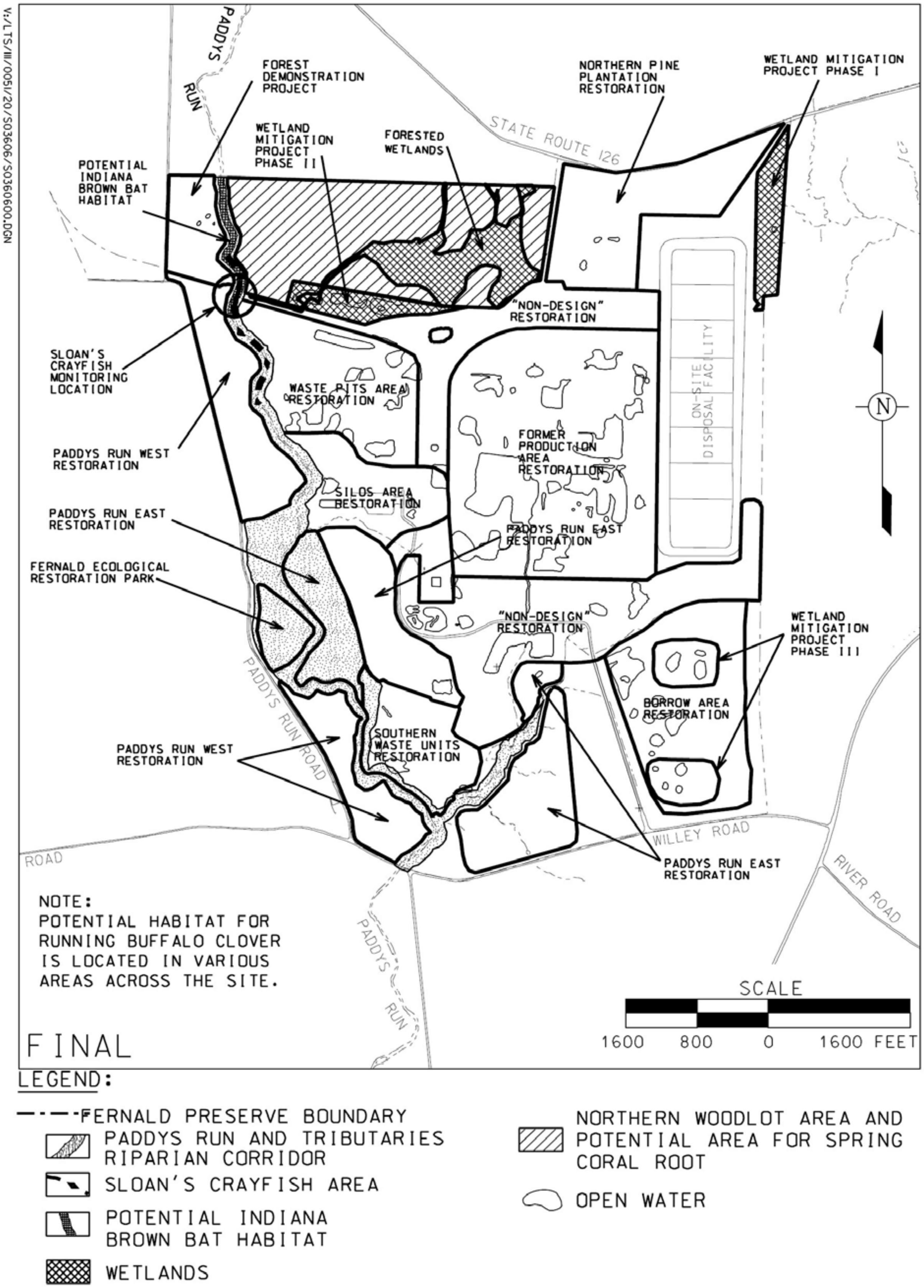

Figure D–1. Priority Natural Resource Areas

Outside expertise may be used in limited circumstances depending on the type of monitoring to be conducted. A description of the monitoring strategies to be implemented at the Fernald Preserve is provided below.

4.1 Threatened and Endangered Species

The state-listed threatened Sloan's crayfish (*Orconectes sloanii*) and the federally endangered Indiana brown bat (*Myotis sodalis*) are the only threatened or endangered species to have a known population at the Fernald Preserve. However, there is the potential for other state-listed and federally listed threatened and endangered species to have habitat ranges that encompass and/or occupy the Fernald Preserve. Monitoring will continue to track the status of the Indiana brown bat populations and their habitat. If activities take place at the Fernald Preserve that could potentially impact the Sloan's crayfish habitat, active monitoring of those areas will resume. Monitoring for several other listed species that may be present at the Fernald Preserve will take place if potential habitat would be impacted by site activities.

4.1.1 Sloan's Crayfish

The state-listed threatened Sloan's crayfish is a small crayfish found in the streams of southwest Ohio and southeast Indiana. It prefers streams with constant (though not necessarily fast) current flowing over rocky bottoms. A large, well-established population of Sloan's crayfish is found at the Fernald Site in the northern reaches of Paddys Run. In dry periods, the crayfish retreat to the deeper pools that remain, primarily upstream of the former rail trestle, located approximately at the boundary between Hamilton and Butler counties. A significant population of Sloan's crayfish also resides in an off-property section of Paddys Run at New Haven Road.

This species resides with one other competing species of crayfish (*Orconectes rusticus*) that is generally considered more aggressive. In addition, the Sloan's crayfish is sensitive to siltation in streams.

Impacts on Sloan's crayfish are similar to those on other aquatic organisms in Paddys Run. Impacts of concern would include excavation and alteration of the streambed along with increased siltation and runoff into Paddys Run. With the majority of onsite soil disturbance now complete, habitat impacts are not expected. If the potential for impacts does return, a Sloan's crayfish management plan will be put in place. This plan would detail monitoring and contingency plans to mitigate impacts.

4.1.2 Indiana Brown Bat

Good to excellent summer habitat for the federally listed endangered Indiana brown bat (*Myotis sodalis*) has been identified north of the former rail trestle along Paddys Run. The habitat provides an extensive mature canopy from older trees and the presence of water throughout the year. In 1999, one adult female was captured along Paddys Run and released. Potential impacts to Indiana brown bat habitat would include tree removal and/or stream alteration in the northern on-property sections of Paddys Run. Because the bats use loose-bark trees for their maternal colonies, removal of trees would impact this species by eliminating its summer habitat.

The habitat of the Indiana brown bat was monitored during remediation activities to identify any unanticipated impacts during remediation. A follow-up survey was conducted in the summer of 2002 as a result of remediation activities north of the train trestle along Paddys Run. No Indiana brown bats were found during this survey.

DOE and the agencies agreed to keep the former rail trestle in place after a thorough review of the impacts that would result from its removal. The trestle was modified to promote use by bats. Additional monitoring will be conducted in 2008 to determine the extent of bat use.

Monitoring methods for the Indiana brown bat would consist of visual observations of that activity and mist netting in areas suitable as bat flyways and where canopy occurs. Mistnetting would occur between May 15 and August 15, because some bats begin to disperse for winter shelter in late August. Data recorded at each sampling site would include type of habitat, water depth and permanence, type of bottom, tree species and size, and presence of hollow trees or trees with loose bark in the vicinity.

In addition to mistnets, bat detectors (which indicate bat activity) would be used during all sampling to detect echolocation calls near the net. The number of calls on the detector would be recorded to indicate the effectiveness of the nets in relation to bat activity. Bat detectors can also be used to sample areas of marginal habitat to determine if netting should be attempted.

One such sampling event took place in the summer of 2007. While several species of bats were collected, no Indiana brown bats were captured. Visual monitoring for bat activity will be conducted through 2008.

4.1.3 Running Buffalo Clover

Surveys conducted in 1994 of the federally listed endangered running buffalo clover (*Trifolium stoloniferum*) found no individuals of this species at the Fernald Site. However, because running buffalo clover is found nearby in the Miami Whitewater Forest, the potential exists for this species to establish at the Fernald Site. The running buffalo clover prefers habitat with well-drained soil, filtered sunlight, limited competition from other plants, and periodic disturbance. This plant is a perennial that forms long stolons, rooting at the nodes. The plant is also characterized by erect flowering stems, typically 3 to 6 inches tall, with two leaves near the summit topped by a round flower head. In the event surveys are necessary, they would be conducted between May and June, which is the optimal time frame for blooms. An appropriate number of transects would be walked in suspect areas to identify the running buffalo clover. If populations are discovered, then best management practices will be used to minimize impending impacts, if any.

4.1.4 Spring Coral Root

The state-listed threatened spring coral root (*Corallorhiza wisteriana*) is a white and red orchid that blooms in April and May, and grows in partially shaded areas of mesic deciduous woods, such as forested wetlands and wooded ravines. Although surveys conducted in 1994 and 1995 indicated no individuals were present, suitable habitat exists in portions of the northern woodlot.

A floristic analysis for the northern woodlot and associated northern, forested wetland was conducted in 1998. This analysis showed that no spring coral root was present in the northern woodlot.

4.2 Wetlands/Floodplains

Approximately 11.87 acres of on-property wetlands adjacent to the former production area were impacted as a result of contaminated soil excavation. The 26-acre northern forested wetland area and associated drainage characteristics were avoided and protected during remediation activities. A mitigation ratio of 1.5:1 (i.e., 1.5 acres of wetlands replaced for every one acre of wetland disturbed) was negotiated between DOE and the appropriate agencies (i.e., EPA, OEPA, U.S. Fish and Wildlife Service, and Ohio Department of Natural Resources). As a result of this agreement, 17.8 acres of new wetlands had to be established to compensate for the impacts during remediation.

Wetland mitigation was initiated at the Fernald Site in 1999. Approximately 6 acres of wetlands were constructed within a 12-acre ecological restoration project along the North Access Road. Monitoring requirements for this wetland area have been completed. Two other wetland mitigation projects have been completed: Area 6, Phase I; and the Borrow Area. Monitoring for these two project areas will continue during legacy management under DOE-LM. More detailed monitoring requirements are discussed in the NRRDP for each project.

4.3 Cultural Resource Management

All field personnel must comply with the procedure, Unexpected Discovery of Cultural Resources, if cultural resources are uncovered during ground disturbing activities. In the event that ground-disturbing activities must occur during legacy management, limited monitoring will occur in all areas that have been surveyed to identify any unexpected discoveries of human remains (Figure D–2). More intensive field monitoring will take place only in areas known to have a high potential for archaeological sites as determined by previous investigations. In most instances, discovery of human remains in previously surveyed areas will require data recovery work. Disturbance of previously unsurveyed areas will require at least a Phase I investigation. An annual summary of all cultural resource field activities is provided separately from the IEMP under the Programmatic Agreement for Archeological Activities at the Fernald Site. Monitoring of cultural resource areas will continue during legacy management to ensure that the areas are not being disturbed, as is described in the Institutional Controls Plan.

4.4 Restored Area Monitoring

Restored area monitoring is required following the completion of natural resource restoration work. Monitoring of restored areas involved two phases, implementation phase and functional phase monitoring. However, only implementation phase monitoring is currently ongoing at the site.

Implementation phase monitoring is conducted to ensure that restoration projects are completed pursuant to their NRRDP and to determine vegetation survival and herbaceous cover. There must be 80 percent survival of all planted vegetation in any given restored area, determined by mortality counts. There must be 90 percent cover for any seeded area, with 50 percent being native species.

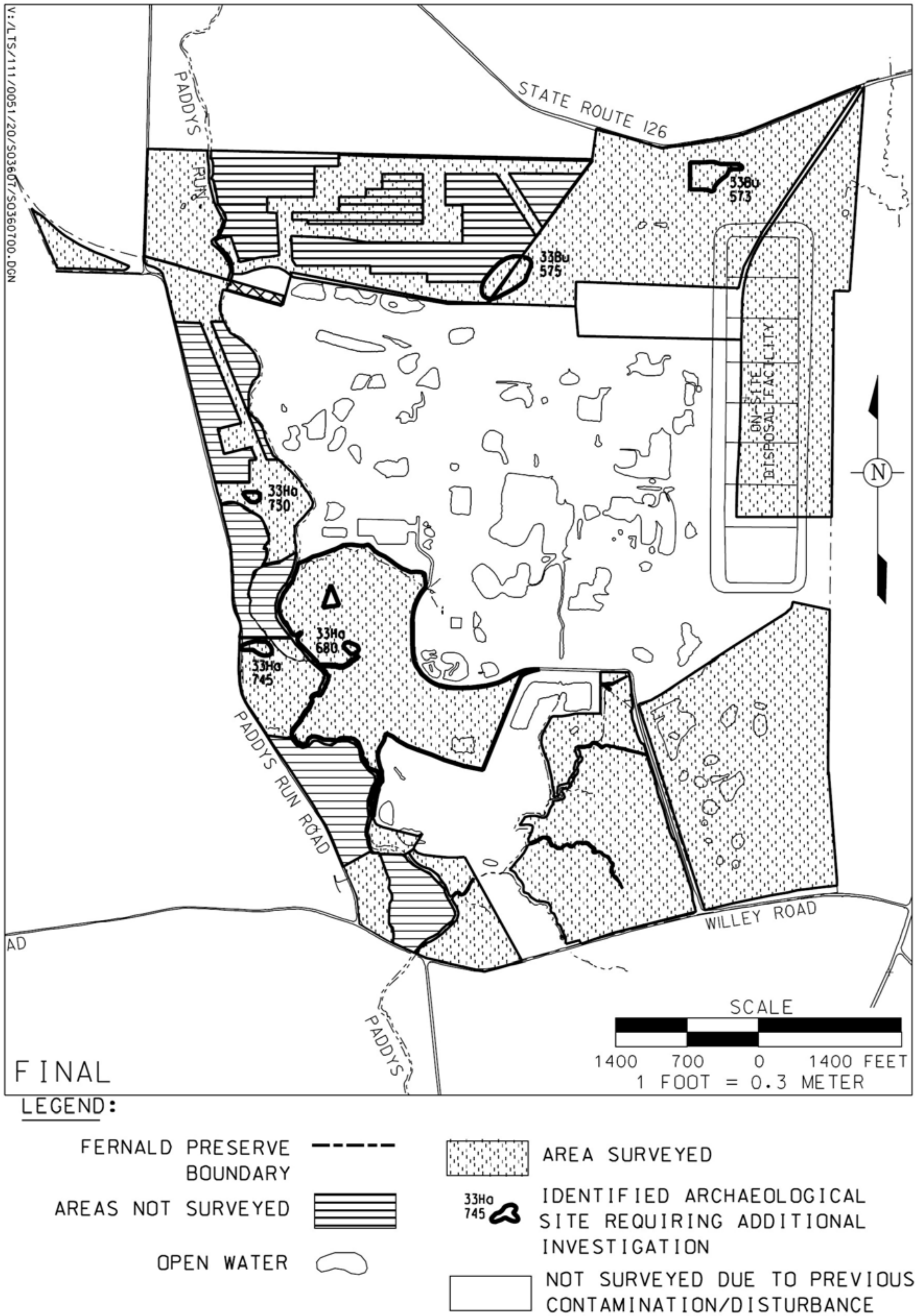

Figure D–2. Cultural Resource Survey Areas

Functional phase monitoring was conducted to evaluate the progress of a restored community against pre-restoration baseline conditions and an ideal reference site. Woody and herbaceous vegetation were evaluated for species richness, density, and frequency. Size of woody vegetation was also recorded. Currently, no further functional monitoring is scheduled for any restored area. The last round of functional monitoring was conducted in the fall of 2005.

4.4.1 Implementation Phase Monitoring

To determine vegetation survival, mortality counts are conducted at the end of the first growing season. Each container grown tree and shrub will be inspected and assigned one of four categories: alive, resprout, vitality, or dead. Trees and shrubs will be considered "alive" when their main stem and/or greater than 50 percent of the lateral stems are viable. "Resprout" trees and shrubs will have a dead main stem, with one or more new shoots growing from the stem or the root mass. Plants will be categorized as "vitality" when less than 50 percent of its lateral branches are alive. "Dead" trees will have no signs of life at all.

For seeded areas within a restoration project, the Natural Resource Trustees agreed to a 90 percent cover survival rate for cover crops (necessary for slope stabilization and erosion control) and 50 percent survival rate for native species at the end of the implementation monitoring period as a goal.

All seeded areas are evaluated within each restoration project. Depending on the size of the restoration project, seeded areas may be grouped into habitat-specific sub-areas. For each distinct area, at least three one-meter square quadrats are randomly distributed and surveyed. Field personnel will estimate the total cover and list all species present within each quadrat. The data collected will be used to determine total cover, percent native species composition, and relative frequency of native species, as described below.

For total cover, the quadrat-specific cover estimates will be averaged. Percent native species composition will be calculated by dividing the total number of species surveyed into the total number of native species present. The relative frequency of native species will be determined as follows. First, DOE will record the number of times each species appears in a quadrat. To obtain the frequency, the number of times a species appears in a quadrat will be divided by the total number of quadrats surveyed. Next, the frequencies of all native species will be summed and divided by the total of all frequencies within a given area.

By collecting the information described above, DOE will evaluate implementation phase success of seeded areas based on two criteria. First, 90 percent cover must be met by the end of the first growing season. Second, the goal of 50 percent native species composition or relative frequency must be obtained by the end of the implementation monitoring period. These criteria address both erosion control and native community establishment, which are the two primary goals of seeding in restored areas.

Implementation phase monitoring for all restoration projects was completed in 2007. However, additional monitoring may be required in future years in order to ensure adequate herbaceous cover and vegetation survival. DOE will evaluate data collected in 2007 and determine whether corrective actions and/or additional monitoring are necessary.

4.4.2 Implementation Monitoring for Mitigation Wetlands

Area 6, Phase I, and the Borrow Area are the only wetland mitigation projects that will require implementation monitoring in 2008. The requirements for the wetland areas are typically for 3 years following completion, instead of just one as with the other restoration areas. The monitoring requirements are also more extensive. Monitoring includes water level measurements, water quality sampling, soil sampling, and wetland plant (herbaceous cover) surveys. Implementation monitoring for mitigation wetlands will be carried out under DOE-LM, and the requirements are spelled out in the NRRDP for the project. Monitoring of Area 6, Phase I was originally to be completed in 2007. However, given the extremely dry summer, DOE determined that it was necessary to suspend the final year or monitoring until 2008.

4.4.3 Functional Monitoring

Currently, negotiations are still ongoing for the Natural Resource Damage Settlement. The negotiations include functional monitoring requirements. At this time, no further functional monitoring is scheduled for any restoration area. However, the outcome of the settlement may require that functional monitoring be resumed. In that case, details of the functional monitoring methodology and the areas that require functional monitoring would be included in the next revision of the Comprehensive Legacy Management and Institutional Controls Plan and this IEMP. If functional monitoring of restored areas is resumed at the Fernald Preserve, the monitoring activities would be carried out under DOE-LM.

4.5 Natural Resource Data Evaluation and Reporting

The results of natural resource monitoring will be integrated with the annual reporting, a commitment in the IEMP. Annual site environmental reports will provide appropriate updates on unexpected impacts to natural resources and the results of specific natural resource monitoring that have been implemented (e.g., monitoring of crayfish, cultural resources, etc.). A summary of the findings will be provided in the site environmental report. A detailed discussion and evaluation of the available data will be presented in the appendix to the site environmental report. Significant findings as a result of natural resource monitoring will be communicated to EPA and OEPA as needed.

End of current text